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HAMMOND, H. P., Director of S. P. E. E. Summer School, 99 Livingston Street, Brooklyn, N. Y.

OUR FORTIETH ANNIVERSARY MEETING

By R. A. SEATON, President of the Society

Our fortieth anniversary meeting at Chicago, June 26 to 30, 1933, should be one of the best and most largely attended meetings in the history of the Society. The Armour Institute of Technology will be our host and the Stevens Hotel will be our headquarters. A splendid program has been planned and excellent arrangements have been made for handling the meetings. Most of the meetings will be held in the hotel, which is conveniently located with respect to both the Century of Progress Exposition grounds and the business center of Chicago, known as the loop district. Very low railroad fares will be in effect throughout the country, and as Chicago is centrally located it can easily and cheaply be reached either by railroad or automobile.

As the national professional engineering societies will be holding their summer meetings in Chicago at the same time that our meeting is to be held, a unique opportunity is afforded our members to attend the meetings of our Society and of their own national professional society, and to see the Century of Progress Exposition, all on one trip. This is an opportunity that no engineering educator can afford to miss. In these unsettled and troublous times it is even more important than usual that engineering teachers keep in touch with changes and trends in engineering education, with progress in the engineering colleges, and with industrial and engineering developments.

Our Society is in a thriving condition. During the past year we have added almost as many new members as we have lost old ones, the net loss being less than two per cent. Our expenditures have been kept within our income and the end of the year is expected to show a small increase in the balance in our treasury. The activity of our sections has reached the highest point in our history during this year. Your president has made a special effort to attend as many section meetings this year as possible and he has found everywhere record attendances, splendid programs, and great interest in the work of the Society. The committees of the Society have been active during the year and numerous conferences sponsored by the committees and the divisions are scheduled for the annual meeting.

All of these factors indicate that we shall have a most interesting, informative, and inspirational meeting at Chicago. Do not miss it!

FINAL PROGRAM OF THE FORTIETH ANNIVERSARY MEETING

FORTY-FIRST ANNUAL MEETING OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

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STEVENS HOTEL, CHICAGO, ILL.

June 26, 27, 28, 29, 30, 1933

TIME SCHEDULE

MONDAY

	Section	Location
9:00 A.M.	English	West Ball Room
2:00 P.M.	Coöperative Engineering Education	Private Dining Room 4
	English	West Ball Room
6:00 P.M.	Council Meeting	* Chicago Woman's Club
6:00 P.M.	Dinner, Wives of Council Members	* Chicago Woman's Club
6:00 P.M.	Dinner, Divisions of Drawing and English	Tower Ball Room
8:00 P.M.	Bridge for Ladies	Chicago Woman's Club

TUESDAY

9:00 A.M.	Business Session	Main Dining Room
2:00 P.M.	Coöperative Engineering Education	505
	Joint Meeting, Industrial Engineers and Society of Industrial Engineers	West Ball Room
	Joint Meeting, Drawing and Orientation and Engineering Problems	505A
	Mechanics	457
8:00 P.M.	Smoker	Stevens Hotel

WEDNESDAY

Engineers Day ..... Century of Progress

THURSDAY

9:00 A.M.	Business Session	Main Dining Room
2:00 P.M.	Junior Colleges	505A
	Coöperative Engineering Education	505
	Mechanical Engineering	457
	Machine Design	556
	Sections and Branches	557
7:00 P.M.	Annual Dinner	Tower Ball Room

FRIDAY

9:00 A.M.	Business Session	Main Dining Room
2:00 P.M.	Institutional Division	Grand Ball Room

* All other meetings held in the Stevens Hotel.

OFFICERS OF THE SOCIETY

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General and Executive

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Stanley E. Winston, James C. Peebles,
Ernest Kelly, Charles A. Nash

HEADQUARTERS AND REGISTRATION

The Headquarters of the S. P. E. E. is in the Stevens Hotel, Michigan Boulevard, Chicago. Registration will be conducted in the north end of the second floor Lounge of the Hotel. Members of the Registration Committee will be on duty from 8:00 A.M. to 9:00 P.M. throughout the convention.

COMMUNICATIONS

Mail and telegrams should be addressed S. P. E. E., Hotel Stevens, Chicago, Ill., and will be delivered at the registration desk.

TIME

All meetings will be run on Central Daylight Saving Time.

ENTERTAINMENT

The Local Committee will be glad to make arrangements for those who wish to play tennis or golf. Guests cards may be obtained at the registration desk.

TRANSPORTATION

As an Associated Society of the American Association for the Advancement of Science the members of this Society are entitled to the Receipt Certificate Plan which gives the concession of one and one-third fare. This concession is applicable to members and the dependent members of their families, provided that certificates are obtained at the time of the purchase of your going ticket and that the certificate is endorsed in Chicago by Mr. Sam Woodley, Executive Assistant, American Association for the Advancement of Science. These certificates should be deposited at the time of registration. They will then be validated and returned to you later. Members should consult their local passenger agents for rates.

PROGRAM

MONDAY, JUNE 26, 1933

A.M.

9:00 Conference on English, West Ball Room, Miss Sada A. Harbarger, Chairman.

Methods for Increasing Effectiveness of English Composition. Walter Hendricks, Armour Institute of Technology.

Discussion Leaders: Joseph A. Ayers, University of Louisville; Robert L. Blair, University of Illinois; C. F. DeLaBarre, Virginia Polytechnic Institute.

Tests for Acceptable and Reliable Habits of Writing. John M. Stalnaker, University of Chicago.

Discussion Leader: W. W. Hatfield, Editor, *English Journal*.

P.M.

2:00 Conference on Coöperative Engineering Education, Private Dining Room 4, A. R. Cullimore, Chairman.

Effect of the Present Economic Dislocation on our Coöperative Program. Geo. W. Burns, University of Cincinnati.

How Massachusetts Institute of Technology Has Handled the Cooperative Course During This Situation. W. H. Timbie.

Conference on English, West Ball Room, Miss Sada A. Harbarger, Chairman.

Developing Reading Habits: A Symposium.

Leaders: T. J. Donahue, Polytechnic Institute of Brooklyn; W. R. Dumble, The Ohio State University; J. R. Lowe, Case School of Applied Science; A. H. Townsend, New York University.

Scope and Type of the English Teacher's Service. H. L. Creek, Purdue University.

6:00 Dinner meeting of the Council, Chicago's Woman's Club. Guests of Armour Institute of Technology.

Dinner and bridge for wives of Council members, Chicago Woman's Club. Guests of Armour Institute of Technology.

Dinner meeting of Division of Drawing with Division of English, Tower Ball Room.

Illustrations of the Engineering Reports. Thos. E. French, The Ohio State University.

Writing and Illustrating Engineering Material from the Sales and Publicity Viewpoint. Ralph Leavensworth, Westinghouse E. & M. Company.

English of the Engineering Reports. J. Raleigh Nelson, University of Michigan.

TUESDAY, JUNE 27, 1933

A.M.

9:00 First Business Session, Main Dining Room, R. A. Seaton, President, presiding.

Function of Engineering Schools in the Social Life of the Community. Willard E. Hotchkiss, President, Armour Institute of Technology.

Presidential Address: Function of Engineering Schools in the Economic Life of the Country. R. A. Seaton, President of the Society.

Effect of its Engineering Schools on the Economic and Social Life of Europe. W. E. Wickenden, President, Case School of Applied Science.

Origin of the Society. A. N. Talbot, University of Illinois.

Report of the Treasurer, W. O. Wiley.

Report of the Secretary, F. L. Bishop.

P.M.

12:30 Informal luncheon of teachers of Mechanics.

2:00 Conferences:

Coöperative Engineering Education, 505, A. R. Cullimore, Chairman.

Coöperative Work as a Laboratory for Industrial Management for Personnel Problems and Problems in Human Relations; Some suggested forms of technique. H. H. Metzenheim, Newark College of Engineering; Fred E. Ayer, University of Akron; Robert C. Disque, Drexel Institute; B. M. Brigman, University of Louisville; E. H. Flath, Southern Methodist University; S. Fishman, Newark College of Engineering.

Mechanics, 457, A. E. Norton, Chairman.

Advanced and Graduate Study of Mechanics:

Demands of Industry for Engineers with Better Understanding of Mechanics. G. M. Eaton, Spang-Chalfant Company.

What Shall We Do with Graduate Students? J. P. Den Hartog, Harvard Engineering School.

Demonstration of Models Showing Vibration and Other Phenomena of Dynamics. J. G. Baker, Westinghouse E. & M. Co.

Joint Meeting, Division of Drawing and Division of Orientation and Engineering Problems.

A Coördinated First Year Course in Engineering. E. R. Wilcox, University of Washington.

Advantages and Disadvantages of a Coördinated First Year Course. F. C. Dana, Iowa State College.

General Role of Geometry in the Physical Sciences. F. W. Bubb, Washington University.

Orientation Program at Purdue University. Justis Rising, Purdue University.

Business meeting.

Joint meeting, Committee on Industrial Engineering and Society of Industrial Engineers, West Ball Room.

Place and Scope of Industrial Engineering in the College Curriculum. F. V. Larkin, Lehigh University; Paul T. Norton, Virginia Polytechnic Institute; Dexter S. Kimball, Cornell University; Willard E. Hotchkiss, Armour Institute of Technology.

8:00 Smoker, Stevens Hotel, Guests of Armour Institute of Technology.

WEDNESDAY, June 28, 1933

This is Engineers' Day at the Century of Progress Exposition and a number of engineering societies are participating in joint activities. Due to the fact that the members of this Society are not interested in just one phase of engineering, the Program Committee has not arranged for a planned tour of the Exposition. There will be a general assembly at the grounds of the Century of Progress in front of the Hall of Science at 10:30 A.M. Short speeches by prominent engineers will be delivered after which there will be conducted trips to exhibits of particular interest. S. P. E. E. members may join the group in which they are most interested. The afternoon will be left free for trips and an inspection of the Exposition. A joint dinner will be held in the evening at the Stevens Hotel. There will be addresses by prominent speakers and dancing after the dinner. The admission will be $3.00 per person. (This dinner is not to be confused with the regular annual dinner of the Society for the Promotion of Engineering Education which will be held at the Stevens Hotel on Thursday evening, June 29, the price of which is $2.00 per person.)

THURSDAY, JUNE 29, 1933

A.M.

9:00 Second Business Session, Main Dining Room, H. S. Rogers, Vice President, presiding.

Professional Development of the Engineer. R. I. Rees, American T. & T. Company.

Change in Attitude of the Profession to Engineering Schools. A. S. Langsdorf, Washington University.

Interchange of Faculties of Engineering Schools. D. C. Jackson, Massachusetts Institute of Technology.

Discussion: D. S. Anderson, Tulane University; J. W. Barker, Columbia University; O. J. Ferguson, University of Nebraska; H. S. Rogers, Oregon State College; Geo. C. Shaad, University of Kansas.

Comparison of Present Curricula with Curricula in 1908. Wm. T. Magruder, The Ohio State University.

P.M.

2:00 Conferences:

Round table on Junior College, 505A, Walter B. Jones, Chairman.

Coöperative Engineering Education, 505, A. R. Cullimore, Chairman.

Benefit of Coöperative Experience from Radio and Public Service Employment to Electrical Engineering Students. H. B. Duling, Georgia School of Technology.

Symposium: Value of Operation and Maintenance Work in the Coöperative Program. Led by C. C. Winn, Detroit Institute of Technology.

Some Experiences with Operation and Maintenance Jobs in Industrial Work. Frank J. Oliver, University of Detroit.

Mechanical Engineering, 457, B. M. Brigman, Chairman.

The Mechanical Engineering Course. J. R. DuPriest, University of Minnesota.

Course in the Mechanics of Fluids. H. L. Mason, Columbia University.

Machine Design, 556, F. L. Eidmann, Chairman.

Can Inventive Ability Be Developed by a Course in Mechanical Invention? Geo. M. Bartlett, Purdue University.

Sections and Branches, 557, H. S. Rogers, Chairman.

History of the Organization of Sections and Branches. Charles F. Scott, Yale University.

Purpose, Function, Organization and Promotion of Sections and Branches. H. S. Rogers, Oregon State College.

Coördinating the Sections with the National Society. R. A. Seaton, Kansas State College.

Program Planning for Sections and Branches. D. S. Kimball, Cornell University.

Round table discussion.

7:00 Annual Dinner, Tower Ball Room, President R. A. Seaton, presiding.

Personalities of Engineering Educators. Dexter S. Kimball, Cornell University.

Honoring the Charter Members.

Presentation of the Lamme Medal.

Election of Officers.

FRIDAY, JUNE 30, 1933

A.M.

9:00 Third Business Session, Main Dining Room, Paul Cloke, Vice President, presiding.

Post-Graduation Education for Engineering Graduates. V. M. Faires, Texas A. & M. College.

Application of Educational Philosophy to the Educational Process in a Professional Engineering Course. R. S. Sweigert, Georgia School of Technology.

Promotion of Engineering Education during the Past Forty Years. H. P. Hammond, Brooklyn Polytechnic Institute.

Engineering Aptitudes. Clair V. Mann, Missouri School of Mines.

Vocational Guidance in Engineering Lines. J. A. L. Waddell, New York City.

Reports of Committees.

P.M.

2:00 Meeting of the Institutional Division, Grand Ball Room, Vice President Paul Cloke, Chairman.

New Opportunities for Technical and Engineering Graduates. Frank B. Jewett, Bell Telephone Laboratories.

New Trends in Engineering College Curricula and Enrollments in the Light of the Present-Day Conditions. Robert H. Spahr, General Motors Institute.

A General Course in Engineering. Paul Cloke, University of Maine.

Adjournment.

PLACEMENT EXAMINATIONS IN MATHEMATICS AT THE UNIVERSITY OF MINNESOTA, 1925–32

By R. F. SCHUCK,

Assistant Professor of Drawing and Descriptive Geometry

Iowa Placement Examinations have been used in the mathematics aptitude and training tests given to entering freshmen in the College of Engineering and Architecture and School of Chemistry at the University of Minnesota since 1925. The results of these examinations have been compiled and studied for the purpose of discovering any trends in the average mathematical ability of these students when entering the University.

The Revised forms were used in 1925. The Revised A forms were used in 1926, 1928, 1929, 1930, 1931, and 1932. The Revised B forms with a few Revised forms were used in 1927. The three forms contain the same type and number of problems. The corresponding problems appear to be of the same degree of difficulty. Assuming this to be true the scores are directly comparable and a fair degree of reliance may be placed upon deductions made from a study of them, providing the students had not been made familiar with, or given special training for, the examinations previous to the time of administration.

The material of the Aptitude form includes:

(1) Formation of number series
(2) Questions on simple mathematical relations
(3) True-false questions
(4) Tests of ability to read with understanding

The Training form consists of:

(1) Problems in arithmetic
(2) Algebraic problems
(3) True-false questions (principally geometry)
(4) Miscellaneous mathematical problems

Definite time limits are assigned to each part and instructions for scoring are given on both aptitude and training forms. The actual time allowed for the work of each test is 40 minutes. The maximum possible score for aptitude is 65 and for training is 75.

Both examinations were given to entering freshman students *in the week before instruction began* for all groups shown in Table

I. They were conducted and the results were scored by members of the faculty in accordance with the instructions given with the test forms.

The training examination alone was given in the high schools of Minnesota in the spring of 1932 to 83 students who later entered the College of Engineering and Architecture. These 83 students took the same identical examination again in the fall of 1932, together with the 153 other entering freshmen. (See "Repetition Effect in Iowa Mathematics Training Examinations" published in this journal March, 1933.) Table II shows the variation in results of the examination given under the different conditions recited above.

TABLE I

PLACEMENT EXAMINATIONS IN MATHEMATICS AT THE UNIVERSITY OF MINNESOTA,

1925–32

Students in Engineering, Architecture and Chemistry

Year	Iowa Math. Aptitude Exam.				Iowa Math. Training Exam.			
	No. of Stu.	Lowest Score	Median Score	Highest Score	No. of Stu.	Lowest Score	Median Score	Highest Score
1925...	328	5	28.9	57	328	1	33.0	61
1926...	287	1	25.1	60	286	5	31.7	69
1927...	375	1	27.9	59	330	6	36.2	66
1928...	433	3	30.5	55	434	6	32.5	65
1929...	502	1	28.5	63	496	7	32.8	69
1930...	498	2	31.9	61	504	6	36.0	68
1931...	418	0	32.2	57	422	10	40.7	65
1932...	244	6	36.1	61	153	16	47.7	71
Maximum Possible Score = 65					Maximum Possible Score = 75			

The graphical representation in the diagram is based on the results given in Table I.

In observing the tables and diagram, a clear conception of the meaning of a median score should be kept in mind. As an example, consider the score 28.9 which appears in the median score column for the year 1925 in Table I. This means that in the group of 328 students who took the mathematics aptitude examination in 1925, 50 per cent scored below 28.9 and 50 per cent scored above 28.9.

In general, the trend of scores is upward indicating improvement in performance on these examinations. It will be observed that the last three years show a very pronounced upward trend.

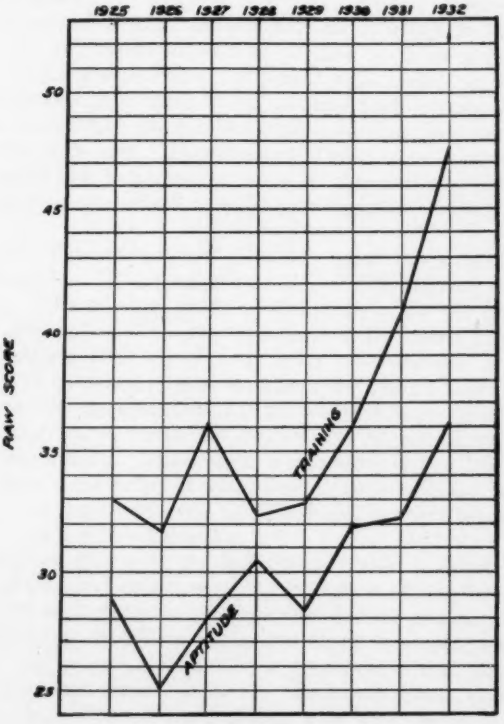
TABLE II

IOWA MATHEMATICS TRAINING EXAMINATION

	No. of Stu.	Lowest Score	Median Score	Highest Score
First Attempt* March, 1932, in High School	83	6	44.1	61
First Attempt Univ. of Minn. Fall, 1932	153	16	47.7	71
Second Attempt* Univ. of Minn. Fall, 1932	83	23	52.1	66

* This group is not included in Table I or in the graphical representation.

IOWA PACEMENT EXAMINATIONS IN MATHEMATICS, UNIVERSITY OF MINNESOTA



MEDIAN SCORES

ENGINEERING, ARCHITECTURE, AND CHEMISTRY

Whether or not this is due entirely to greater mathematical ability of the entering students is perhaps a debatable question, but it is my opinion, based on observation of students in my university classes, that increased mathematical ability has been an important factor in the improvement shown.

None of the 1932 group entered the University with less than three years of high school mathematics whereas previously about one-third of the entering students had had only two or two and one-half years. It seems reasonable to assume that the better preparation of the 1932 group had some bearing on the unusual performance in the fall of 1932.

Similar studies at other universities would be interesting in comparison with this one at the University of Minnesota.

STUDY OF MATHEMATICAL ABILITY IN RELATION TO SUCCESS IN ENGINEERING STUDIES

By THOMAS JAMES HIGGINS,
Cornell University

With the increasing tendency to offer curricula composed of more and more theoretical subjects and less "practical work" such as shop and drawing courses, the ability of the engineering student to handle abstract studies with success is becoming of increasing importance. At the present time the engineering curriculum is largely composed of subjects such as physics, heatpower, hydraulics, electrical theory, and the like, all of which are theoretical and abstract in content depending as they do upon mathematical formulæ for their expression. It would seem logical to argue that if the student is to pursue these subjects with success he should possess an inclination for mathematics or at least be able to handle mathematics with ease. Therefore, it is the purpose of this paper to investigate the relationship between the mathematical ability of the engineering student and his success in the engineering curriculum.

Data for the study were obtained from the records of the men graduated in 1932 from the School of Engineering of Cornell University. The average grade of the student for his entire four years was selected as the index of success in the school curriculum. In his freshman year every man must take courses in analytic geometry and calculus. These courses total eleven hours and are the only ones in mathematics that the student is required to take. The average grade of these two courses was chosen as an index of mathematical ability. These data were obtained for 153 men.

These men were grouped according to their average in mathematics and the mean average of the four year grades was computed for each group (Table 1).

With the exception of the last group, Table 1 shows that the scholastic averages decrease with decrease in mathematics average. The mean for each group is less than that for the groups preceding it. The standard deviations show that there is considerable overlapping of the groups. However, it is probable that if a larger group of men had been considered the overlapping would have been much less. This is particularly true with reference to the first two or three groups where the frequency is comparatively small.

TABLE 1

Math. Average	Frequency	Mean 4 yr. Average	Standard Deviation
91	8	83.99	4.16
87	6	82.44	5.01
83	16	80.24	3.91
79.5	13	77.94	4.16
76	29	75.50	3.17
71.5	25	74.98	3.33
67	26	74.20	2.95
61.5	14	72.40	2.70
56	5	71.45	2.66
49.5	11	73.70	2.56
	N = 153		

The mean grade of the last group is of special significance. This group has a scholastic average comparable to those men having a mathematical average of 67. This last group is composed of men who have received either E and F or D and F in their mathematical courses. Without doubt, this increased average is due to greater selectivity operating in this group over the four years. In other words, of those who receive an F in one of their mathematics courses, only the best survive to receive a degree.

Therefore, Table 1 would seem to indicate that there was a definite positive correlation between mathematical ability and success in engineering studies. To check this assumption, a correlation between the Mathematical Average and the Mean 4 yr. Averages for the groups of Table 1 was computed and a value ($r = .84$) obtained. Such a high correlation can leave little doubt.

In order to ascertain the effect of the undue selectivity operating in the last group (as pointed out above) a second correlation involving only the first nine groups was made. Here it was found that $r = .92$.

Figure 1 is a frequency curve of mathematical averages of the students. As is to be expected with a group of this size (153) we have a fairly regular normal frequency curve.

Figure 2 is the frequency curve of four-year averages for individuals. This curve is sharply skewed to the left, that is the lower end of the distribution. It will be seen that most of the men have grades between 70 per cent and 80 per cent. Of those studied, 119 or 78 per cent fall within this group. It is significant that only six of the remaining thirty-four have scholastic averages less than

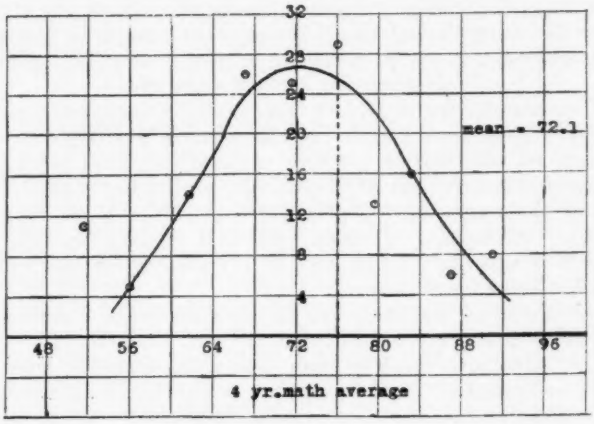


FIG. 1

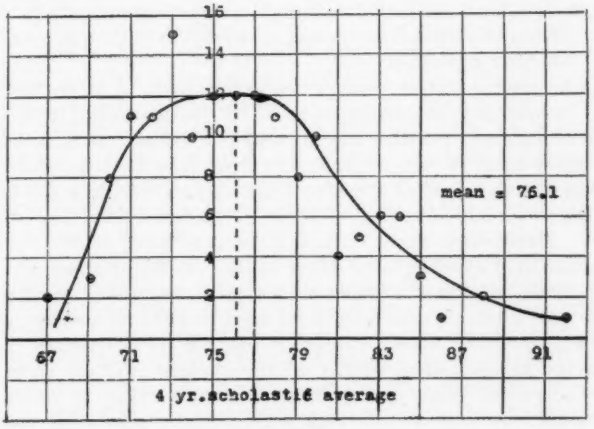


FIG. 2

70 per cent and there is none lower than 67 per cent. Therefore, those who start and whose work is of a caliber less than 67 per cent are likely to be eliminated before taking a degree.

Comparison of Figs. 1 and 2 reveals one startling point. The mean of the mathematical averages is 4 per cent lower than the mean of the four-year averages. Such a low mean, 72.1 per cent, and such a difference in means is indicative of several factors that

might be to the student's disadvantage in his engineering studies. Either his mathematical talent is somewhat meager or else he is not as interested in the mathematical courses as he might profitably be.

If we consider the records of those students whose mathematical average is equal to or greater than the mean of the four-year class averages, we find that 68 per cent of these men have averages in the group of grades from 80 per cent up. Only 3 out of 43, or 7 per cent, of these men have grades lower than the mean four-year average. Once again, it would seem that we can conclude that students of superior mathematical ability will do the best work in the engineering curriculum.

The results of this study can be but meager and somewhat inadequate because of the small number of men studied. If a careful study of 1,000 men could be made the results would be more conclusive and reliable. As it is, we seem to have obtained a criterion and a measure of success in the engineering school. While we cannot predict for individuals we can predict for groups of individuals their ultimate success in the engineering school on the basis of their freshman mathematical marks. In effect this study shows that students of superior mathematical ability will do superior work in the engineering school.

If the results of this study are at all reliable they can be made use of in one very important way. With the increasingly theoretical curricula and with the five-year course of study that is now being planned in most of the major engineering schools, it is of increasing importance to select the men from those applicants for admission that will have the best chances of success in the engineering school. Heretofore, these men have been selected on the basis of their secondary school record, those having the highest being chosen. Since we do not know whether or not good secondary work means that a man is capable of doing good work in the engineering school, but since we have found a definite positive correlation of .84 between the mathematical ability of the student and his success in the engineering school, what is more natural than to choose the applicants on the basis of their mathematical marks in the high school.

It might be argued that there is a great deal of difference between secondary mathematics and higher mathematics and the correlation for one might not hold true for the other. We do not definitely know, and it would be a most interesting study and a most valuable one to determine, the relationship between the success of the engineering student in school and his work in secondary mathematics. If a definite positive relationship could be found between these two, then we would have a sure way of picking those applicants that will have the best success in the engineering schools.

SECTIONS AND BRANCHES

The **Colorado School of Mines Branch** held its last meeting of the academic year on May 15. It was a dinner meeting and the speaker was Dr. T. C. Poulter, physicist of the Byrd Antarctic Expedition on the coming trip to the South Pole. Dr. Poulter is professor of physics at the Iowa Wesleyan University. He found that the methods used by the Colorado School of Mines on measuring the thickness of ice by geophysical methods are exactly suited to his needs and may have his instruments built at the School.

Ohio Section.—One hundred and one engineering teachers and practicing engineers from Ohio, Michigan and Kentucky representing sixteen colleges and universities registered at the Annual Meeting of the **Ohio Section** held May 6 at the University of Toledo. J. B. Brandeberry, University of Toledo, and J. A. Dinwiddie, Chairman, The Affiliated Technical Societies of Toledo, welcomed the Section, and E. A. Hitchcock, Dean College of Engineering, The Ohio State University, gave the response. President Seaton of the Society, who was also in attendance at the meeting, made some appropriate remarks concerning the significance of section meetings and their value to the Society. This meeting at Toledo was distinctive because of the large attendance, the range of interests and experience of the members, the number of educational institutions represented, the quality of the program, the animated discussion and the unity of the thinking on engineering education in these times.

Both of the addresses—that on " The Shifting Emphasis in Engineering Education," by W. E. Wickenden, President, Case School of Applied Science, in the morning, and that on "What Does Industry Expect from Technical Education in the Next Decade," by C. F. Hirshfeld, Chief of Research, Detroit Edison Company, in the afternoon—were clear, vivid, effective, thought-provoking, and full of constructive suggestions as to how engineering education can contribute not only to the future well being of the profession but also to the solution of the large social and economic problems of the country.

At the business meeting a motion was passed that the Michigan Section, when formed, should be invited to affiliate with the Ohio Section. The following officers were elected from 1933–1934:

Chairman: S. B. Folk, The Ohio State University.
Vice Chairmen: F. L. Plummer, Case School of Applied Science; B. C. Schad, University of Dayton.
Secretary: Sada A. Harbarger, The Ohio State University.

Professor W. T. Magruder, The Ohio State University, moved that a vote of thanks be given to the Trustees, the President, the Dean and the Faculty of the University of Toledo for their hospitality; to the Committees on Arrangements and Program, including the Secretary, for their services; to President W. E. Wickenden for his thought-provoking paper of the morning session and to Dr. C. F. Hirshfeld for his very timely and valuable paper of the afternoon; and to President R. A. Seaton for his attendance at the Annual Meeting of the Ohio Section of the Society for the Promotion of Engineering Education. This motion was passed by unanimous vote.

FACTORS IN AN ENGINEERING PROBLEM AND THEIR APPLICATION TO ENGINEERING EDUCATION *

By H. C. SADLER,
Dean, College of Engineering, University of Michigan

The well known adage that a clear and proper statement of a problem is half its solution, is one that contains the suggestion that it would be well to put some thought upon setting up a problem with all its component factors and, if possible, giving the proper amount of weight or value to each.

While the more physical or engineering types of problems are capable of expression in some cases in a somewhat simple mathematical or algebraic form, and in others, by the more complicated devices, such as the differential equation, those that involve some of the more intangible values such as occur in the considerations involving education are not quite so simple. Be this as it may, at any rate, there would seem to be some advantage at least of attempting to set up the problem of the Education of an Engineer in the same manner as other equations, even if it is impossible to apply the methods of the mathematician to its solution.

Until the publication of the S. P. E. E. Investigation on Engineering Education, individual opinion, with the inevitable extremes, formed the basis as to what should be included and what emphasis should be placed on certain types of work in an undergraduate course in engineering. Following the report certain general facts were established which represented a more composite opinion as to the elements which should receive attention of those interested in the training of future engineers.

A recent symposium at the opening of the Packard Laboratories at Lehigh University, threw some more light upon the subject from two sources: the University or Technical College, and the Industries.

* Presented at the meeting of the Ohio Section, S. P. E. E., May 6, 1933.

Before proceeding to summarize the information at hand it would seem to be advisable to discuss the term "Engineer." The old definition is too well known to bear repetition, but today it would seem that the category of individuals to be included in the term might properly be enlarged. As originally formulated, it applied more specifically to the professional engineer, technician, or specialist; and to-day this is the prevailing connotation abroad, so much so that in certain countries an engineer occupies a rather exalted place in the professional ranks.

In the United States, unfortunately, the term "Engineer" has been so widely used as to constitute almost an abuse, and has come to be applied indiscriminately to the driver of a locomotive, apartment house or hotel attendant, plumber, or even mortuary engineer, as well as to designers of bridges, machinery, hydraulic and steam power plants, ships, etc., or those devoting their lives to the scientific development of the profession.

From the figures obtained in the above report, it is evident that roughly two thirds of the graduates of engineering schools eventually land in the more administrative or managerial type of work; about thirty per cent in what might be called primarily technical or professional lines, and the remainder in sales and miscellaneous callings. In the earlier stages of their careers, the largest group were usually engaged in the more technical pursuits.

It would therefore seem not only justifiable, but also logical, to designate the whole group as "Engineers," both from the fact that their original training was of an engineering character, and also because in most cases their present status is largely due to the fact that their engineering experience has formed an essential factor in their selection. From all indications it would appear that in the future there will be an increasing demand for men of the engineering type of training for responsible positions in Industry, rather than for those who have specialized in the more specific business or financial lines.

At this point it might be well to emphasize the fact that in the above group it was not only their technical knowledge that led to advancement, but also their interest in and knowledge of other things, such as economics, finance, personnel problems, etc. Even in the smaller professional group, except with all due respect to our colleagues in the teaching profession, an appreciation of the above extra-technical matters, particularly those involving finance, has probably had much to do with their professional success.

To put the matter in a concise form, so far as the professional engineer is concerned, it is quite possible to design an engineering structure of any nature which might be the acme of perfection so far as its efficiency from a purely engineering point of view is con-

cerned, but when the cost is considered, its efficiency might drop to zero because it would be economically impossible to proceed with its construction.

In the first place, and as a basis from which to draw analysis for conclusions regarding the education of an engineer, it would seem desirable to set up, in simple form, the factors which enter into any engineering problem. While these will naturally vary somewhat in both number and relative weight, at least a few of the fundamentals can be selected as a basis for all branches of the profession.

In most cases the term "efficiency" will probably give the best picture. This also has the advantage that when various factors are to be taken into account, the product will represent what is generally termed "overall efficiency." No attempt will be made, however, to give any weighted values.

If, then, we represent by "E" the "overall efficiency" and by "e_1," "e_2," "e_3," etc., the various factors entering into the problem, we may express the result as follows:

$$E = e_1 \times e_2 \times e_3 \times e_4 \times e_5 \ldots e_n.$$

As an indication of what the various constituent factors might represent, the following are submitted:

"e_1"—*Purely engineering, scientific or design efficiency.* As illustrations, this would include such things as fuel economy and general efficiency of various types of prime movers, utilization of high grade materials or special alloys, economic proportions of dimensions, etc. If no other factor were present, this would mean that the engineer would have absolute freedom to adopt what he considered to be the latest and most economical design, but if other factors be taken into account, it is quite possible that the adoption of some less efficient forms under this heading might lead to a better overall efficiency.

"e_2"—*Financial or economic efficiency.* This would include all questions relating to first costs of the installation as a whole or the constituent parts. Interest and depreciation charges, and particularly the latter in some projects, form a significant factor in cost of operation.

"e_3"—*Operative efficiency.* All too often this factor is neglected by the designer or builder. The influence of handy methods of shop production oftentimes lead to difficulties and undue expense for overhaul or accessibility for minor repairs. Ruggedness in design, reliability or freedom from possible breakdown, the time during which full power or peak and overload are required, absence of vibration or noise, or such items as fuel

costs, water supply, etc., will sometimes assume dominant positions in the solution of a problem.

"e_4"—*Personnel.* In some cases this might properly be included as a part of operative efficiency, but in others, may assume a separate place as representing the human versus the material side of operation. Difficulties of obtaining skilled workers, considerations of machines and men together rather than machines alone, may have an important bearing on the ultimate design.

While the above by no means exhaust the possible factors that may enter into any engineering problem, they would appear to be the more important or, at any rate, will occur in nearly all problems.

There are, however, one or two other aspects of the general question which are involved where the product of an engineering design may depend upon its saleability. Many illustrations will occur to anyone, and perhaps the automobile is a good example. Here, in addition to the non-engineering items mentioned above, namely, cost, economy, operation and personnel, other questions involving artistic effects and psychology, particularly that relating to the "female of the species," may assume significant places.

Closely allied to the foregoing, are those things which involve the social order, such as municipal or governmental operations, where a knowledge of sociology, government or politics may be of assistance in reaching a solution fitted to certain special cases. These last considerations might, perhaps, be grouped as "e_5."

The above may be taken as a general statement of the various facts upon which an engineer is called upon to philosophize before reaching his conclusions as to the major features of design. After these are settled, the engineer as a specialist, may then begin to take up the detailed solutions of the problems in his particular field.

If the picture as outlined above is a true one and represents what an engineer should do in any case, cannot the same idea be applied to his training in earlier years?

The same general equation can be used with an extension of the concept of the term "*E*" to include Effective or Efficient Education.

For the constituent factors on the right hand side we can now substitute teaching or courses whose content is such as to give the varying degrees of intensity of training which would equip the student with sufficient knowledge to understand what is indicated under the actual objects e_1, e_2, etc.

The function of an institution of learning which includes in its title the term "Engineering," will naturally place the primary importance on the training involved in what is commonly known as

engineering as distinguished from law, medicine or any other profession. As this is one of applied sciences, a knowledge of the fundamental sciences which must be applied at a later stage, will, of course, be included. These are too well known, and have been the subject of much discussion during the past few years, to call for further remarks in this paper. The difficult matter to settle will always be the proportion of weight or time to be devoted to the fundamental sciences and engineering courses proper in the whole course.

There will probably always be a tendency to crowd out or reduce to a minimum, the non-technical terms represented by e_2, e_3, e_4, etc.

Corresponding to the factor e_2, the financial or economic phase, we would have those studies which are generally included under the caption of Economics. While the order of importance of the various terms in the equation is somewhat difficult to determine and would vary in different fields, I think it would be safe to place this factor in the second place. For the same reasons as discussed under the engineering problem itself, a familiarity with the principles of Economics, which would at least bring to the student's mind the necessity of taking this subject into account, would seem to be a very essential part of his training. In this connection there has been some discussion as to the complexion that such courses should assume, and an insistence in some cases that these should be of the engineering type, or Engineering Economics. This subject, so far as engineering is concerned, really falls under two headings; first, the utilitarian, and second, the broader or sometimes called cultural value. It would seem undesirable to make it a purely engineering subject as it contains a number of general considerations with which the well educated engineer as a citizen should certainly be familiar. It is also doubtful if the professional economist would have sufficient knowledge of engineering problems to give an effective course; and the professional engineer might tend to smother the general principles in a mass of specific examples. The solution would seem to be to obtain the coöperation of the economists as to certain emphases in the general content, and introduce the specific engineering applications in the various technical design courses.

The factors e_3 and e_4, which bring in questions relating to operation and personnel can possibly also be included without much difficulty in technical courses relating to design, or in some cases, made the subject of special treatment. In any case they represent important phases of the subject to which sufficient attention should be drawn so that the students will at least realize that they must be considered as part of any problem.

The studies represented by the final term, e_3, in the engineering problem, would include all those of the more general and cultural nature which have practically no engineering content; art, music, history, political science, English, and foreign languages and literature, psychology, philosophy, and so forth. In this connection I would venture the suggestion that some training in philosophy or the philosophical method is something that must be acquired sooner or later by almost any engineer.

The above equation, representing the statement of the problem is fundamentally one that suggests the proper grouping of all facts, the weighing of each and deciding upon its relative importance in order to obtain a really correct and not an unbalanced solution—which, after all, is the philosophic method.

One might even make the assertion that the solution of an engineering problem today is two thirds philosophy and one third engineering. Perhaps I have exaggerated the proportions, but even so, a study of the suggested equation and the arguments presented would seem to show that placing undue emphasis on narrow and intensely technical matters, is certainly not the proper way to educate the coming generations of engineers.

In conclusion, I would also draw attention to the fact that an engineer's training does not stop when he leaves the cloistered walls of the college or university. He must continue to be a student until nature compels him to cease. Why then should we strive to compress the work of a lifetime into four years? Fundamental principles will never die, although they may possibly be modified by the advance of knowledge, but specific applications are the butterflies which enjoy a glorious but short life, passing out of existence to make way for the more advanced creature of the future.

WHAT DOES INDUSTRY EXPECT FROM TECHNICAL EDUCATION IN THE NEXT DECADE *

By C. F. HIRSHFELD,
Chief of Research, Detroit Edison Company

History shows plainly that man has always sought prophets who could chart for him the events of the enigmatic future. If we omit from consideration such cryptic and evasive utterances as those which characterized the Delphic Oracle and others of similar ilk and study the predictions of those who made specific statements we find the prophets more often wrong than right. At least, that is the way I read history; and particularly more modern history in

* Presented at the meeting of the Ohio Section, S. P. E. E., May 6, 1933.

which we may assume that we have more nearly correct and complete statements. I, for one, am convinced that the human brain is not yet equal to the task of prophesying.

It is therefore with some trepidation that I appear before you today scheduled to speak on what industry will require within even so short a period as the next decade. I would not do so at all if it were not for the fact that I believe I can tell you something of value with regard to what industry requires now. We may be safe in assuming that the requirements will remain somewhat similar for a few years and possibly for as many as ten or even more.

I am certain that the greatest need of industry at the present time is for technically trained men capable of occupying, or of growing into, executive and administrative positions. By this I do not mean what most of you will naturally assume. I do not mean men who have been given a superficial training in economics, industrial relations and industrial management in a course labelled Industrial Engineering or something else of similar significance.

The crying need is for men with flexible brains capable of rigorous thinking in both technical and non-technical lines. Such men are to a certain extent born and not made. However, much can be done by education. Given reasonably good raw material, a properly conducted education will do much toward developing what I have in mind.

I would warn you however to differentiate clearly between the names of courses of study, the subject matters given in those courses and the method of teaching that is used. We shall shortly have a plethora of graduates of courses bearing some such label as Industrial Engineering. And many of them will be very nearly useless since experience shows that these courses are taken largely by the lazy and the incompetent individuals who are either unwilling or unable to endure the rigors of a proper engineering curriculum. Such men are not going to meet our needs.

What a man studies is in one sense of the least importance. How he studies is of the greatest importance. And, in the long run, how he studies is determined largely by how he is taught. I cannot stress too greatly the importance of the teaching method as against the significance of the subject taught. Having said this you are quite justified in asking me to be specific with respect to my conception of proper teaching.

Permit me parenthetically to bring to your attention a small pamphlet recently published by the Department of Vocational Education of Iowa State College under the title "Booklet of Teaching Skills." The title is not well chosen since it would lead one to believe that the pamphlet dealt with the teaching of manual skill as in vocational training. As a matter of fact it treats the

subject of skill in teaching. And it treats that subject very well indeed. Any teacher should profit from the reading of it.

Returning to my conception of proper teaching, I would say, first, that teaching for the purpose now under discussion should be directed primarily to the cultivation of the ability to think independently. All too many of our teachers of engineering regard their task as consisting of the implanting of certain definitely prescribed factual knowledge. Little of the factual knowledge actually implanted will later be used as such by the graduate in his industrial life. He may use some of the memorized facts as bases from which to reason or by way of producing mental and physical analogies, but he will usually not use them as the teacher fondly hopes he may.

In developing the facts of engineering we use certain elegant and masterly concepts of wide application. Too many teachers stress the results rather than the methods used in developing those results. If the student once understands the grand, overall concepts, he possesses the tools with which he can obtain results for himself to fit any given case. Speaking as a practically minded employer of engineering graduates, I find all too many who can solve problems only to the extent to which they can fit the conditions into some formula learned in college or found in an engineering handbook. Put them up against something that is not amenable to such treatment, and they are lost. Why? Because they do not know the ways in which such formulas are produced. Because they have been taught a collection of facts rather than the thinking processes by which such facts, and others, can be deduced from certain general concepts.

From my point of view the teacher of engineering may be said, in general, to stress too greatly the specific results of the application of certain methods to certain assumed conditions, and all too little the methods themselves. It is the methods that are of greatest value in after life because the specific conditions which are met are seldom exactly those that were considered in college.

My second criticism is that the teaching of engineering is not, in general, sufficiently loaded with the dollar sign. As an ex-teacher I am aware of the readiness with which this statement can be misunderstood. I do not mean that it is necessary to give in college the actual market prices of different materials and mechanisms. Such prices mean little, change constantly and after all are merely facts readily determined in practice for any given set of conditions. I refer to something entirely different and which may possibly be best described as a mental attitude.

Let me put it this way. The academic mind naturally dwells largely in the world of ideals. In college we solve problems most

frequently by assuming ideal conditions which are impossible of actual attainment. I refer to such concepts as frictionless mechanisms, perfect heat conductors and perfect heat insulators, perfectly elastic materials, absolutely uniform dielectrics, perfect heat engines, etc. This mental attitude just naturally leads the academic mind to stress those things which lead to the closest approach to ideality. As a result the student frequently leaves with a very warped sense of values. It is frequently difficult for him to reorient himself and accept, for example, the fact that a very inefficient machine or engine of some sort may be economically the most efficient. The waste of energy or of fuel or of water or of metal or of some natural resource will be abhorrent to him, with the result that he loses sight of the waste of the dollar or of human effort or of something else that he has not been taught to think about.

This result flows primarily from the mental attitude of the teacher, an attitude which I have already admitted is a very natural one for him to acquire. From my point of view it is essential that teachers of engineering recognize this tendency and balance it constantly if they hope to produce the type of engineer that is capable of rising to any heights in industry. It is essential that they recognize and implant in their pupils the idea that real engineering consists almost entirely of how to effect the best compromise in any given case. The compromise is usually one between many different divergent factors—of which cost of one sort or another is by no means the least.

Possibly I can give you my thought in this way. The teacher naturally starts by obtaining the technically ideal solution. If he then modifies it because of economic or other considerations this is, to his mind, an unfortunate necessity and he impresses that fact upon his pupils, consciously or otherwise. The practising engineer of value to the world starts from a different base. In fact, he views the problem primarily from almost a diametrically opposite standpoint. He wants to produce a certain economic result; how can this be best achieved? The extent to which he has to depart from the technically perfect solution worries him not at all because from his point of view the economically perfect result is the ideal and the technically perfect result is of no interest except possibly in a purely academic way.

My third criticism of our present teaching is the almost complete failure to recognize the fact that real engineering concerns itself almost as much with the human element as it does with natural forces, materials, machines and structures. Let me illustrate what I mean by referring first to a different but closely allied field. Have you ever studied residences, office buildings or hotels with

specific reference to the location of lights, furniture, windows, telephone, doors, etc. If you have you will have discovered that the structure and its contents very seldom seem to fit together. The reason is simple enough. Very few architects really consider the human element sufficiently when designing the structure. Admittedly, it is impossible to predict all the types of equipment and arrangements thereof which the occupants of such structures will want to use. But this is no excuse for putting together a structure in which it is impossible to use a single practical arrangement.

Structurally, the buildings may be perfect; artistically they may be perfect; but they do not represent a perfect solution of the entire problem because they are not as well adapted to human use as they might be and should be.

The engineer who has received a good college education of the modern type develops a sense of power over materials, structures and natural forces. He can bend them to his ends at will. He comes to with a start when he discovers that many of his problems are made exceedingly difficult because he does not have a similar power over the people who necessarily enter upon the stage of practical endeavor. If he is not one of the few unusuals he develops a sense of futility. What good is it to be able to produce technically and economically correct solutions if he cannot make his workmen produce them at a price that permits a profit, or of a quality that enables sales, or if he cannot persuade his clients or the public to accept his product?

This angle of our work is very complicated, not only because of the difficulty of analysing in advance the reactions of human beings singly and in mass, but also because of the many different ways in which engineering work contacts the human being. I can give you only one golden rule which the engineer may use for his guidance in this connection. It is, "In all matters and in all respects maintain yourself perfectly and perpetually human being conscious." It is a golden rule indeed in our business and probably in all other business.

Now you may well ask how is a teacher to impart this characteristic to students. By observing exactly the same rule. Whenever you teach and whatever you teach, always bring in the human being. Are you teaching machine tool design? Well then, instead of dealing only with the mechanics and the kinematics, consider also the adaptation of the machine to the worker. How must it be built so that he can stand or sit in a comfortable position? How must it be built to enable him to make all necessary movements of hands, arms, legs and body with the minimum of fatigue? How must it be built so as to insure the greatest degree of safety to the worker? And, of course, the machine must be sold if it is to be an article

of commerce; therefore it should be studied from that angle also. The sales arguments based upon the superiority of this design over other available designs should be brought out and the effect of finish and general appearance upon sales appeal should not be overlooked.

Again, are you teaching power plant design? It is not sufficient to determine the sizes of boilers, firing equipment, turbines and generators, steam lines and the rest and to then put them together into a technically correct assemblage. You should make your students consider the way in which the plant is to be operated and maintained. How is access had to the various valves? How can valves and pipes be arranged so that the operator does not have to duck under them or step over them as he moves about the plant? Where are you to place the parts of dismantled machinery during maintenance and repair operations so that the maintenance crew can do its work properly? What path can the chief engineer follow through the plant on regular inspection trips so as to see all essential parts with the minimum of fatigue? How are the workers to enter the plant, how is their time going to be kept, how and where are they to change their clothes, what happens if a watch engineer finds it necessary to leave during his watch? All these things are just as important, if not more important, than the exact calculation of sizes of much of the equipment, in that they determine to a great extent the economic results that may be obtained.

Some of you undoubtedly teach experimental engineering and you are probably wishing you could dare me to show how the human factor can be brought into your work. I accept the unvoiced dare. There are two distinctly different ways in which this can be done. Experimental engineering always deals with machines of some sort, testing machine, fan, engine, what not. A wise teacher will point out the ingenuity displayed in placing valves, levers, oil cups, etc., at exactly the places where an individual naturally reaches them or expects to find them and he will be even more careful to point out the instances in which a man must stand on his head to inspect a given part or must construct a special oil can to reach a certain bearing and so on. A very little of this sort of thing makes the student alert to the fact that machines are, after all, used by human beings and that they will be best used when they best fit the human being.

The other way in which the teacher of experimental engineering can bring in the human touch and its significance is in connection with the reports which the student writes. Many a valuable sermon can be preached with such reports as texts. Impress upon the student the idea that the purpose of the report is to convey ideas to others. He makes a poor beginning if the report is so sloppily

prepared that the intended reader is immediately prejudiced against it. He does not achieve his purpose if part of what should be in the report remains in his brain, unwritten. He does not achieve his purpose if the reader cannot determine without a meticulous reading of every word what the report is about, how the work was performed, what results were obtained and what conclusions can be drawn from them.

In real life reports are used to convey ideas from one human being to another. They must be built for that purpose. This can be done best as one studies the human being, not the experiment.

You may question whether such methods of bringing the human being into the equation will produce the desired results. I answer that they will in just the same way that constant reference to the conservation of mass and energy make these ideas a fixed and unshakable part of the student's mental possessions. It is only necessary that he think instinctively of the human relations and aspects of a problem just as he thinks instinctively of the impossibility of obtaining perpetual motion. You can trust him to work out the solutions in each case for himself just as soon as he realizes that the human aspect of the problem exists.

I believe that I can assure you that such things as I have spoken of are far more important in the training of engineers for executive positions than all the "isms" that you can work into a curriculum. And I feel that these are the lines along which our teaching is at present most deficient. Please note that you do not need large endowments and huge equipments for this sort of teaching. But, I fear that you do need a lot more teaching of teachers and a lot more careful supervision of teachers. We seem in academic circles to assume that if a man knows a subject he is qualified to teach it and we rest on that assurance. I fear that we frequently rest on a very insecure foundation.

Thus far I have been talking of the training of men who are destined to occupy managerial and executive positions. I would not have you assume that an adequate supply of such individuals alone will meet our needs. We shall still require technicians of all grades, from the draftsman up to the skilled research worker. In this field also I feel that we need an improved product.

We need men who are less followers of precedent and more independent workers. We need men so well skilled in the fundamentals and their application to practical problems that they can use those fundamentals in the analyses of new types of problem. We need men who can invent by the application of fundamentals rather than by the unconscious processes that have been used by the typical inventors of the past.

I think that it is possible to produce a better product of this type without any radical modification of curricula and without any huge investments in equipment. To my mind the principal part of the job is here also the method of teaching.

We need a much better training in the underlying or fundamental studies such as mathematics, physics, chemistry and mechanics and then we need a much better correlation of these studies with those that are built upon them. With the teaching arrangements that are now most prevalent each of the underlying or foundation subjects is built into a separate cell in the student's brain and almost hermetically sealed therein. They are said to be necessary stepping stones to an engineering education but why or how is left largely to the student's imagination or lack of it.

I firmly believe that the time has come when the heads of our engineering schools must give very serious thought to the mechanics of the job. Is mathematics taught purely as an exercise in logic or purely as an abstract science or as a tool for engineering purposes? Does the teacher of mathematics know how the engineer uses it? Do the teachers of engineering subjects know what mathematics their students have actually had, not what the courses were called, and do they know how that mathematics was taught?

Does the professor of physics speak of vapor tension where the professor of heat power or of thermodynamics speaks of vapor pressure? Does the professor of thermodynamics indicate that the atmospheric humidity that the professor of physics spoke about is the same thing that he is calling superheated or saturated steam as the case may be? Do all the professors, when they discuss the automatic reactions to disturbance of systems in equilibrium draw the student's attention to the fact that these are but specific examples of a general law? Or does each professor treat his own little example as a unique sort of a happening divorced from all natural law except that labelled with the particular names used in his branch? Does the professor who treats of the idealized harmonic motion of the reciprocating engine piston know how the idealized harmonic wave of electrical engineering was taught to the same students, and do the professors of these and other branches in which harmonic motion occurs tie together their mathematical treatments and physical concepts? Or do they each go their own sweet ways and leave the student to work out his own salvation? In other words, are things coördinated or are they all at sixes and sevens. If you ask the student he can tell you. My own observations of teaching methods and of the resultant products lead me to believe that a much greater degree of coördination is both possible and necessary if your product is to measure up to the technical requirements. These boys must be given a much greater comprehension of the

closely knit character of both natural phenomena and engineering studies. They must leave you with a much greater degree of generalized knowledge. I am not asking for the maturity that comes of age and experience; I am asking for a teaching job honestly and understandingly performed within the limits set by time, age and facilities. And I do not think that I ask too much.

To some of you, what I have said will appear as caustic and unsympathetic criticism. To such I would say that for years I was a teacher of engineering and that for many years since that time I have had the opportunity to observe in practice the product turned out by myself and others. This has given me a rare opportunity to appraise my own shortcomings as a teacher and the shortcomings of the staff of which I was a member. I have been quite frank with myself in such appraisal and it may comfort you to know that as a result I have been just as severe in my criticisms of our work as I have been today in speaking to you. After all, we are all concerned in the same problem, namely that of turning out better engineers. In speaking as I have, I have assumed that you would regard my words in this light and not as the unthinking criticisms of one who does not have your problems close to his heart and deep in his understanding.

Before I close, I would like to say one thing more. We must do something to make our engineering graduates not only better engineers but also more rounded and better citizens than they have in general proved to be in the past. Much has been written on this subject recently and I commend it to your careful consideration. To my mind the engineering education properly conducted can be made a marvelous training for enlightened citizenship but we are not now succeeding in making it serve this purpose. We must do something to bring the engineer out of his technical shell and make him personable and human. It can be done if we all set our minds to the task and I feel that it must be done.

Pacific Northwest Section

Upon Friday and Saturday, April 28 and 29, the Northwest members of the Society and engineering educators gathered together at Washington State College for the purpose of organizing a Pacific Northwest Section. Representatives were present from Oregon State College, University of Washington, Washington State College, University of Idaho, and Montana State College.

Sessions were held Friday evening and throughout the day on Saturday. They were attended by numbers ranging from approximately thirty to eighty engineering instructors. Upon Friday evening at an informal dinner at the Washington Hotel at Pullman,

the organization of the Section was completed the following officers were elected:

Chairman—R. D. Sloan, W. S. C.
Vice-Chairman—J. E. Buchanan, U. of Idaho
Secretary—E. R. Wilcox, U. of Wash.

Following the dinner meeting papers were presented by Deans R. G. Tyler andd H. S. Rogers upon the educational reorganization of the University of Washington and of Oregon State College.

At the Saturday morning meeting President E. O. Holland of Washington State gave a stimulating and thought provoking address of welcome in which he presented the challenge now before higher education. Technical papers of the morning session were presented as follows:

"Teaching Standards in Fundamental Subjects"—J. E. Buchanan.
"Practical Methods in Descriptive Geometry"—G. E. Thornton.
"Methods of Developing and Engineering Library"—Ivan C. Crawford.

During the afternoon session the technical program was continued with the following papers:

"Trends in Engineering Curricula"—E. A. Loew.
"Comparison of Engineering Curricula in German and American Universities"—Eric Therkelsen.
"Coördination of Courses in Humanities and Science with Engineering"—G. W. Holcomb.

The evening banquet was held at the College Commons, and a paper on "The Cultural Values of Engineering Education," by Dr. J. G. Woodburn, former Freeman scholar, of Washington State College, was presented.

The interest, enthusiasm, and vigor manifested at this organization meeting was very inspiring. The Section voted to hold its next meeting at the University of Washington in the fall term of the next academic year. A mimeographed copy of the program is included.

H. S. Rogers

Pacific Southwest Section

COMBINED COURSE IN ENGINEERING MATERIALS AND STRENGTH OF MATERIALS *

By G. H. DUNSTAN,
University of Southern California, Los Angeles

For some years the University of Southern California, like so many others, taught the subjects named in the title as separate courses. About three years ago an opportunity to change the system to the combination was afforded, with the results stated in some detail in the paper. The University has no testing laboratory of its own, but arrangements were made whereby a certain amount of laboratory testing could be accomplished and included in the course. The first third is devoted to engineering materials, the work based upon Roy's text, "Materials of Construction," and the remainder upon Poorman's text on "Strength of Materials." At present these have been replaced by Laurson and Cox's "Properties and Mechanics of Materials," following quite closely the arrangement of the text.

To insure study of the text three or four short questions covering subjects in the assignment are given at the beginning of the hour, once or twice a week, but without a regular schedule of quizzes. A one-hour examination is given at the conclusion of the subject, with no questions on this material in the final examination.

Then follows a general discussion of investigation and design, including allowable stresses, serving as an introduction to the subject of strength of materials. The deflection of cantilever beams, and simple beams on two supports is studied by means of the area moment method, with only a single case of the elastic curve equation and double integration to illustrate the more conventional method.

Throughout the entire course the emphasis is on fundamentals, with but little use of formulas other than those of the most fundamental nature. Laboratory work is included in only one semester, due to the lack of facilities. Experience in the course as it has been given seems to make it desirable to consolidate the two semesters of work into one of five hours' credit, under the direction of Professor D. M. Wilson. It will be scheduled for four days per week, one-hour periods, and a two-hour laboratory and computation period on the fifth day, probably on alternate weeks, with the intervening time spent on computations and problems, with the instructor in the room to render needed assistance.

* Presented at the first meeting of the Pacific Southwest Section in Pasadena, Dec. 30, 1932. (Abstracted by H. B. Langille.)

The author discusses the advantages of these computation periods in this course and in mechanics and hydraulics, apparently finding the results very satisfactory. He believes the great advantage of the combined course described lies in the coördination of the laboratory and classroom work, and that the new method is likely to make a more thorough understanding of the subject by the student possible.

ADMINISTRATIVE RECOGNITION OF TEACHING ABILITY

By JAMES C. CLARK,
University of Arizona, Tucson, Arizona

How shall we measure teaching ability? Is the teacher such a person that he gets nearly all his students to do honest, effective and sustained work in his subject, and to like it? If so, he is a teacher of ability, and as to his methods we need not worry over much. Among good methods there is great variety and much latitude, which should not be cramped lest there be loss of initiative or of spirit. There is a wide range of types of successful teachers whose characteristics are difficult to classify. Among them may be recognized the one who has intimate knowledge of his subject, but who possesses little zest for it, with correspondingly small capacity to inspire his students. Another is the one who bubbles over with enthusiasm but whose grasp of theory is barely sufficient to enable him to "get by." Neither is an outstanding teacher. It is to be hoped that the engineering teaching profession may be composed largely of men who manifest abundant enthusiasm for their chosen work, and who also possess thorough knowledge of it, remaining good students all their lives.

The able teacher is sincerely interested in his students. He will feel honored, not bothered, if they come to him with their intimate personal problems. He will always be approachable and genuinely friendly. Too many men show those qualities only in a perfunctory manner.

To many a parent the education of a student means to secure for him certain "advantages." Innumerable commencement addresses have assured such a parent that the only real benefits to come from that education are under two heads: first, he has learned how to be more in harmony with himself and the world, and second, he has learned how to use his energies and faculties for service to his fellow men. But the parents do not hear the polished phrases at such a time and the fact remains that, in the great public mind, education

should provide "advantages." We engineering teachers know this from the hankering the usual student shows for the purely vocational or professional studies, and the all-too-common antipathy for the subjects that are avowedly "cultural." Despite what has just been said, education is generally considered, by those who understand it, to be the only hope of a sadly muddled world, and I am one who believes engineers should run the world. I attach tremendous importance to engineering education.

Aside from the students, who may be assumed to be approximately constant in quality, all such factors in the usual engineering college set-up as the administration, the equipment, and the teaching staff are important, but the last is by far the most important. When one visits the laboratories of famous universities, hours are spent in looking at elaborate machines, delicate instruments, special facilities for research, etc. But nearly always I have come away disappointed, feeling that I had missed seeing that priceless thing, almost the only one that really counted, the spirit of the great teachers of such institutions in operation upon the minds and hearts of their students. Doubtless many of you have had the same experience.

For many years university deans and presidents have not been sufficiently concerned with the kind of teaching that is being done in their institutions. This is particularly true of presidents. Seemingly they are interested in anything and everything that will advertise the schools. Good teaching advertises a school of course, but why does not the quality of teaching interest administrators, especially since education is the main business of the universities? There are several important reasons why it does not, by far the most important of which is that it does not make a loud and immediate noise. It takes years for the results of good teaching to make a showing, and this is an age of bally-hoo and quick results.

Just possibly we in engineering schools are more interested in teaching than are some of our brethren in other fields of work. Dr. C. R. Mann said in his famous "Study of Engineering Education," "The interest in the teaching problem has never wholly disappeared from engineering schools, as it has from some of the universities." Our Society was the first association formed for the study of education in colleges, and it was the only such group for many years. The very origins of technical education in America (at Rensselaer and M. I. T.) are found in the outstanding teaching ability of certain men. Yet Dr. Mann found in the course of his investigation that the study of educational aims, methods and practices was decidedly unpopular among engineering faculties, and that it occupied very little of their time. From my own reading and observation I believe the same situation exists to-day, to a considerable

degree at least. The good administrator gets his staff to do honest, effective, and sustained work and to like it.

We are evidently building, with amazing rapidity, an engineering civilization entailing bewildering effects upon society. It is vitally important that engineers be most carefully and liberally educated. Otherwise they will continue to be mere slaves of the dividend-making machine, rather than true leaders sympathetic with all the elements of a complex world.

The most important factor of any education system is the teacher. So long as positive administrative recognition of teaching ability is lacking, it is inevitable that teachers will slight their teaching in favor of any activity that does promise recognition. This deplorable situation will continue as long as the conditions persist that created and foster it.

ORIENTATION FOR ENGINEERING FRESHMEN

By DANIEL E. WHELAN, JR.,
Loyola University

Those of you who come in contact with engineering freshmen or can even remember back to your own freshman days realize only too keenly the need for some formal way to acquaint the student with the what—when—and why, of engineering. The remarks of Professors Sorensen and Zchokke on the opening day of this session served as good arguments for the giving of such a course.

Three years ago when the pre-Engineering course was begun at Loyola University, it was felt that a formally organized Orientation course would be of great help in quickly establishing that "atmosphere of engineering" so important for the success of engineering studies.

In organizing the course, certain desirable objectives were set and the course shaped to attain these objectives. These objectives were:

(1) To define adequately engineering in the broader sense—to disabuse the mind of the students of their misconceptions concerning engineering and to crystallize for some of them the hazy notions of engineering and engineering study which they possessed.

(2) To describe something of the work of the different engineering professions and of the life in them.

(3) To provide some of the color and romance of engineering history.

(4) To indicate the place and necessity for the subjects of the engineering curricula.

(5) To give some hints on "How to Study Engineering."

One fifty-minute period each week for fifteen weeks was devoted to the course. Twelve lectures are given—a ten-minute period following each lecture being devoted to answering questions of the students suggested by the lecture or discussion. An effort is made to keep the course elastic. While a rather definite lecture schedule is maintained, these lectures are modified or elaborated to take care properly of the questions brought up by the students. It is felt that the major purpose of the course is best served if the student feels that this hour is particularly his in which to present any and all questions affecting his engineering education.

The first lecture is given on the definition of Engineering. The approach to this important discussion is patterned closely to that excellent paper of Anson Marston presented at the annual convention of the American Society of Civil Engineers at Milwaukee in July 1929. Material is liberally borrowed from the pamphlet "What is Engineering" by R. E. Hellmund, Chief Electrical Engineer for Westinghouse and from the article "Engineering" by Professor Charles Edward Lucke in the November 1926 number of *Mechanical Engineering*, and also from "Young Man and Civil Engineering" by George F. Swain. Based on these an attempt is made to define in simple language what Engineering is and what it is not.

This lecture and discussion invariably carries over to the second scheduled period when the discussion is concluded with an exposition of the difference between pure science and engineering.

The third period of the series is devoted to describing the work of the different engineering professions and the life in them. The students exercising their prerogative of asking questions quickly turn loose such a barrage of questions that one wonders why he was vain enough to think he could conduct a course at all. The questions instigated by this one session are in the process of being answered outside of class throughout many ensuing weeks.

In the six lectures on the History of Engineering no attempt of course is made to cover the field completely. The purpose of these lectures is rather to give the student a keener conception of the glorious and honorable background of the profession for which he is preparing to become a part—to stimulate his ambition and to lay the foundation for a healthy professional pride. For such lectures, of course, the sources of material are diverse. Since the purpose is largely to create interest in less mature students the spectacular and unusual phases and events are emphasized. It is not difficult to hold or to create interest in engineering students when recounting the methods by which the Egyptians hundreds of years before Christ cut single stone blocks of 800 or more long tons and transported them for a hundred or more miles. A chrono-

logical sequence of epochal and significant engineering development is attempted; but a very careful effort is made to avoid anything approaching the pedantic. Such facts as that Hero around 200 B.C. built and operated a steam turbine or that the Pont du Gard of the Romans still serves to bring water to Nimes, France, though built some 2000 years ago leaves a definite idea of the character of the era in the mind of the student. An effort is made to leave with the student a proper idea of the debt which the profession owes to such men as Predgold, Telford, Perronet, Vauban, Eads, Roebling, Watt, Stephenson, Corliss, Franklin, Morse, Bell, Marconi, Edison, and many others, as well as to impress upon him that the study of the lives and works of all these men are not barren of suggestion and valuable information for practical appplication in the engineering work of to-day.

Terminating the historical discussion with an exposition of the manner in which engineering advanced with the advance of pure science, provides a natural vantage point from which to discuss engineering curricula. In the lecture devoted to it, the discussion is limited to an attempt to convince the student of the necessity of a comprehensive knowledge of the basic sciences of mathematics, physics and chemistry and to illustrate for him the great practical advantage of such a knowledge. Here again interest is sought by presenting unusual examples of the application of basic principles in modern engineering. The damming of Chute á Cason by the Aluminum Corporation provides a case in point. It is realized that individual teachers of the basic subjects through collateral material effect this same end and the single lecture is devoted to it in this course more as a stop-gap and to present opportunity for students to present questions relating to this phase of the course.

One lecture is given on "Hints on How to Study Engineering Subjects." If time permitted, much more could well be devoted to this important phase of an Orientation course. This phase of Orientation is, however, incorporated into the other classroom work as it is in most other institutions.

Throughout the course reference is constantly made to the publications of the major engineering societies and to leading technical journals. The effort is made to encourage the student early in his career to form the habit of extensive technical reading. The last three periods of the course are devoted to the presentation of prepared reports by the students on material read in technical periodicals. Following the reading of each report time is allowed for discussion by the class as a whole.

In brief, the above is a description of "Orientation for Engineering Freshmen" as it is conducted at Loyola University. After

conducting the course for three years, I feel that the experience warrants its continuance. The course was planned for a specific purpose in a school where the first two years only of engineering are offered. It is a conscious effort to provide engineering atmosphere where there are no extensive engineering laboratories or upper division students from which freshmen could unconsciously absorb atmosphere. It is felt that it fulfilled its purpose.

After attending the course, the student unquestionably is better informed about the profession he is planning to enter. He knows something of its background and something of its modern complexion. He knows why he must study certain subjects in school and knows something of the methods he should use in studying these subjects. The students accept a course like this enthusiastically. There is a multiplicity of questions which keep the conductor busy both in and out of class. I cannot help but feel that the course materially helps the beginning student of engineering properly in starting out on his engineering career.

The groups to which the course was given were small, never exceeding twenty-five. It would seem that this small size of group is a decided advantage. Because of it the course can be kept elastic and informal.

As to whether there is the same need or whether it would be advisable to conduct such a course in a larger institution I am not prepared to say. There are those of you who undoubtedly, from a broader and more mature experience, give greater help along these very lines as a part of your regular class and lecture presentation.

This course was an outgrowth of conversation and discussion of our mutual problem with Professor Constantin I. Anissinoff of Loyola University. Many of his suggestions are incorporated into it. I undertook its conduct realizing rather too well my meager qualifications for doing so. However, in its preparation and conduct I have discovered a very real pleasure and more profit I am sure than any student who attended the class.

COÖPERATIVE EDUCATION

By H. H. BLISS
Riverside Junior College

For about ten years the Riverside Junior College has been carrying on coöperative education in engineering and several other fields. We believe that we have demonstrated that the best part of an education is not given by the college, but is earned by the student himself. By having him work half of the time in the

profession which he hopes to enter we have succeeded in causing the student to achieve a very large part of his education outside of the college halls.

I am sorry to limit this discussion to the coöperative training in one junior college, but I have not been able to find that any junior college, except that of Riverside, has carried on a program of this kind. It had been tried in the East before we began it at Riverside, but according to the President of the institution where it was attempted, political influences were used to destroy the work after it had demonstrated its feasibility to the satisfaction of the College, the students, and the coöperating authorities. We have been fortunate to have met no such opposition.

Since the work has begun at Riverside there have been 186 different individual students who spent one year or more in cooperative employment. The average length of their enrollment in the coöperative course has been about two years. Due to the difficulty of arranging courses on the coöperative basis we have encouraged many students to change over to the regular course for the third year of their attendance at the junior college. Thus they complete the whole course in a total of three years.

We have had a large number of coöperative employers, located chiefly in Riverside, but some of them in other cities and towns, such as Santa Monica, Trona, Idyllwild, El Centro and Los Angeles. The graduates have kept in touch with the Junior College since they left, to a far greater extent than have any of the other graduates. We have had reports from 117 out of the total of 149 who have left the College after one or more years of coöperative work. One third of the 117 have gone to higher institutions for further study. This is a much greater per cent than that of the regular students who spend a year in Junior College. 70 per cent of the 117 have worked, since leaving, in the same profession for which they received training as coöperative students. 37 per cent have worked for the same employer with whom they were placed by the junior college.

Employers have, in general, been much enthused with the cooperation with the junior college. One in particular, an architect, has his whole staff composed of people who are or have been cooperative students. Others have told us that they get better service from our students than they do from other employees of similar age and grade, and still others say that coöperative students do better work than college graduates, in the lowly positions in which it is necessary to begin with their company. Practically every employer would still be carrying a large number of student employees if business conditions permitted.

The effect of the coöperative training on the junior college has been good. Teachers who were at first indifferent, have been won over and all of them are glad to do the extra work necessary to take care of coöperative students on the regular schedule. For one thing the coöperative students have been harder workers in school than the regular students. The last honor roll published gave the names of one student in eighteen of regular students, and one student in four among the coöps. This good work has been partly due to the rigid selection under which the latter students are granted admittance. We require 12 recommended credits from high school (out of the 16 required for graduation) and in most cases we require recommendation from employers for whom the student has done previous work. To stay in the coöperative course we have required the student to please the employer with whom we place him, and to make at least an average of C in his studies in the Junior College.

Finally, in regard to the difficulties which this course has met: The idea that it exists for helping students pay their way had kept out much material that we should have liked to secure. Formerly it was difficult to get sufficient applications from well qualified students, so that occasionally we could not get two to make up a pair for which we had the first one. This occasionally resulted in lowering our standards and the acceptance of an inferior student. We usually regretted it when we made this compromise. At other times we lost jobs which were offered us by employers because we could not fill them satisfactorily. At first we had difficulty in finding employers willing to coöperate. It took a good deal of salesmanship to persuade some of them to try the experiment. Now, however, there seems to be no such feeling on the part of any employer whom we should like to have coöperate with us. Another difficulty was in the administration of small special classes. A small group of coöperative students which would not fit into the regular schedule caused considerable extra work on the part of faculty members who were willing to take care of them.

The one great difficulty, and the one which is responsible for the practical suspension of the coöperative course now, is the depression. Employers find it necessary to keep family men in positions which were previously filled by college students. We can not quarrel with this humanitarian impulse. Our total enrollment at present is only nine students.

In closing, I should like to recommend coöperative courses highly for junior colleges, and even other institutions should make an attempt to start it whenever economic conditions improve to such an extent that it becomes feasible. It offers splendid opportunity to capable, earnest students to secure professional prepara-

tion, it redounds to the credit of the junior college in the community, and it encourages closer relationship between the institution and the employers of the district. It calls for a lot of hard work but the results are ample compensation.

South Dakota

FUTURE OF ENGINEERING EDUCATION *

By E. E. CLARK

School of Mines, Rapid City

In discussing the future of engineering education it is necessary to consider the present and future state of engineers. Three years ago engineering graduates were placed in their respective fields with comparative ease. With the onset of the depression, the demand for engineering graduates dropped rapidly. As a result, but few of the men of the classes of 1931 and 1932 have found places in their specialities. Many recent graduates have of necessity gone into other lines of work, if they are working at all.

The decrease in the demand for engineering graduates from 1931 to 1932 is seen in figures compiled by Secretary Bishop of the S. P. E. E. and made public at the Corvallis convention of the Society last June. The figures are based on reports from 77 institutions, covering some 7,100 students and give percentages of graduates in different branches of engineering placed in positions by June 1st of the years 1931 and 1932.

	1931	1932
Chemical Engineers	43.6 per cent	20 per cent
Civil Engineers	38 per cent	17 per cent
Electrical Engineers	33 per cent	14 per cent
Industrial Engineers	44 per cent	31 per cent
Mechanical Engineers ...	41 per cent	18 per cent
Mining and Met. Engineers	45 per cent	31 per cent

No particular analysis of these figures will be undertaken here. Placement in one or two of the specialties has not decreased as much as in others, but in every branch of engineering only a few graduates of the last three years have found work in the specialty for which they studied. Not only have recent engineering graduates failed to find a place in their specialty, but many engineers with years of experience have found themselves without positions.

Conditions under which our graduates work and live have changed drastically in the last few years and are apt to change

* Presented at a meeting of the South Dakota Section, S. P. E. E., January 12, 1933.

still more. The changes in our technical educational system have been insignificant if change there has been. The attendance in our engineering schools has decreased somewhat in the last three years, but the decrease is insignificant when compared to the decrease in the working forces of industrial concerns employing the main portion of our graduates. Changes in curriculum and course content have been slight, except for a few changes here and there due to reduced budgets.

Although keeping to our course as closely as we can in these troubled times and hoping for a return of so-called normal times, nevertheless, we are beset by fears that far reaching changes are underway. The big question with us is: What is the future of engineering education? No one can answer that question—at least I am not going to attempt it in this paper, but I am going to add to the uncertainty by asking several more questions.

Is engineering education at fault in the present depression, or is it due to the improper application of engineering principles? Technical advance has been rapid in the last few years and industry has eagerly seized each new development, expanded manufacturing facilities for its production and created a demand by extensive advertising campaigns. Very few bankers, or economists, made a protest while industrial plants and industrial man power were being expanded by a forced and ever accelerated selling program. Engineers may have been in doubt about the trend of events, but they have, for the most part, kept silent. The situation is without precedent in the world's history.

Engineering schools have a certain share in the responsibility on account of their failure to impress upon their students a recognition of the economic features which distinguish the world of today from that of 100, or even 30 years ago. There is some reason to believe that our economic theories are sadly out of date and one authority has said that the science of economics is still in the state of physical science before the birth of Galileo.

The engineer, the business man and the advertising specialist have created a world in which one man hour produces 650 times as much pig iron as one man hour in 1832; one man hour in agriculture produces as much food stuff as 3,000 man hours in 1840; one man hour in incandescent lamp manufacture accomplishes as much as 9,000 man hours in 1914. Three million people were unemployed at the peak of production in 1928. It is estimated that if industry were operating today at full plant capacity there would be six million unemployed. If this decrease of man hours is maintained for 50 years, there will be over twenty million unemployed in this country, even with all plants working to capacity. Our debts have increased as the fourth power of the time and each of

us, on the average, owes four times as much as we owned in 1895. Such are the findings of Technocracy—the latest much discussed phenomenon of this engineering age. Perhaps we should not view with alarm, still the findings of this group cannot and should not be ignored.

Is the education of the engineer to follow established lines, or should we change our system after observing the effect of the depression on engineering graduates? Engineering departments have done much work and should continue to expand in the borderland which overlaps with the natural sciences of mathematics, physics, chemistry and biology. Some work has been done, but not equally well established in the borderland which overlaps with economics. Our machines, the product of engineering skill, aided by the sciences of mathematics, physics and chemistry have done us a great deal of good, but until the relation of engineering and economics is worked out in our engineering schools as fully as the relation which now exists between engineering and the natural sciences, there will be a great danger of a great good becoming a great evil.

Should our engineering courses be liberalized? Last spring Professor F. E. Johnson of the Iowa State College sent a questionnaire to all electrical engineering instructors, who were members of the S. P. E. E. Professor Johnson was chairman of the electrical conference held during the Corvallis convention of the society and the questionnaire was sent out in the hope of formulating an interesting program for the conference. One of the questions was: In your observation and judgment what will be the effect of the present depression upon the training of men for electrical engineering? Answers were received from a great many schools representing a good cross section of institutions of the country teaching electrical engineering courses by the elimination of some of the more technical work and the substitution of more economics and social studies.

Practically all engineering courses are hard and require long hours of grind before the student completes one. Most of us point with pride to the fact that our students have to work harder than students do in a good many other college courses. An engineering students schedule is heavy and if he has to earn part of his way through school, he usually has a very crowded four years. Then he is graduated into an industrial world in which he works four or five days a week, if he is fortunate enough to find work at all.

Straight engineering work is on the decrease due to standardization and technological advance and the shorter working day and the shorter working week appear inevitable, even if happy days return again. With shorter hours are going to come more hours of leisure and one of the problems to be solved is the proper use of

leisure time. This is more or less a personal problem to be worked out according to one's tastes, but when worked out incorrectly is going to effect a great many others and thus becomes a question in which society as a whole is interested. If an educational institution trains a man for his life's work, it should also assist him in solving the question of his future leisure time so that it may be spent with profit to himself and to the best interests of mankind.

If our engineering courses are to be liberalized what part of the technical work is to be eliminated? We all agree that the fundamentals should be taught and can remain agreed as long as we don't try to define them. The content of our engineering courses has increased with the years and technical advance until four years is all too short a time to give what we think should be given to an engineering student. Courses have multiplied until it is necessary for a student to take six or eight different courses during a semester and in some cases as high as ten or twelve. This system is a heritage from the lower grades where numberless ideas are impressed on the scholar before he has time to absorb them, resulting in bad study habits and the development, in self defense, of a good "forgetter." Simplicity in education, business and religion is one of the great needs of the day.

If our engineering courses are to be liberalized by the elimination of the technical subjects and the substitution of work in economics and the humanities, three courses are open.

(1) We can turn our students over to these departments and let them take a smattering of one or two courses, with which we are little concerned.

(2) We may coöperate with the social study departments and develop a course, or courses, designed to meet the needs of the engineering student.

(3) We may incorporate the principles of economics and industrial relations within some of our engineering courses.

The first method is the easy way out, the one most commonly used and one which will never bring engineering and the social sciences into as close a relationship as the present state of affairs indicates is necessary. The second method requires close coöperation between the two departments, the realization of which will be difficult in most cases and absolutely impossible in some. The third plan will require exceptional men on the teaching staff, men not only well versed in engineering and economics, but men who appreciate the changes which engineering has wrought in economic ideas and personal relations.

Another question in which all are interested is: How can the economic, social and professional standards of engineers be improved? This is closely related to two other questions, the first:

Are we graduating too many engineers? The second is: What types of engineering education are necessary?

Under present conditions it looks as though we are graduating too many engineers. A large percentage of engineering graduates are going into other fields, even during normal times. One institution finds that at least 60 per cent of its graduates are so engaged. Our present system is very wasteful of material. Of every 100 Freshmen entering our engineering colleges, about 35 finish their work. Probably not more than 5 per cent of the 35 ever reach an outstanding position, while 25 per cent probably meet with reasonable success.

On the other hand, there are those who believe in engineering training, whether completed or not, of benefit to anyone. At the present time the average person comes in contact with the products of engineering skill many times a day. Engineering touches every person more often than the professions of law or medicine, with which most people come in contact only occasionally. An engineering education as a foundation for a legal, business, or political career should enable a lawyer, business man or politician to be more successful in this technical age in which we live.

Engineering educators can be roughly divided into two classes, the first believing in the training of a few specially selected men in a few high class institutions and the second believing in engineering education for the masses. The second group predominates in this country.

It is becoming increasingly evident that if engineers are to be rated professionally with the medical and legal fraternities there must be a selection of students, careful training under the best possible auspices and guidance in the profession after graduation.

A committee composed of representatives of five engineering societies, the S. P. E. E., and the National Council of State Boards of Engineering Examiners is working on the problem at the present time. A tentative program contains the following suggestions.

(1) Educational guidance for young men in secondary schools whose interest is turning toward engineering.

(2) Selection of men as students who it is thought will make good engineers.

(3) Establishment of educational guide lines which mark out broad routes through the college period and early years after college.

(4) Code of educational objectives which will represent a more advanced and mature knowledge in scientific, technical, economic and civic realms than that commonly attained at graduation from college.

(5) Some agency for evaluating educational attainments and professional experience at this more mature level.

(6) Provide means of recognition of professional status at different stages of career.

Many engineering educators hope this increased emphasis upon further education after the college period may relieve the undergraduate curriculum somewhat, allowing better grounding in both the scientific and humanistic groups of studies.

Such a plan will undoubtedly furnish a group from which will come most of the research men and the generals of the engineering army, many of whom will achieve high professional standing, but they will not be enough to carry on in this engineering age. Even though we have this body of specially picked men, a host of average graduates of institutions similar to our four-year engineering colleges and a still larger host from our institutes will be needed.

Another factor which is going to influence engineering education in the future is the question of licensing engineers. Whether engineering educators desire such a condition or not it is here to stay. The big question is going to be: Are the licensing authorities going to license the engineers we educate, or are we going to educate the engineers the licensing authorities license?

For a long time all boys were trained to be President. Then for a time they were trained to be professional men. Now we are training boys to get jobs. I think the engineering student should be taught to live in the present age. He must learn that all engineering graduates cannot become chief engineers and that he must be satisfied with the lower walks of life, if necessary. He should be assisted in developing the proper attitude toward his leisure time. He should be taught that man is more important than the machine and that his happiness and success in life depend as much, or more, upon his knowledge of human engineering as upon his knowledge of technical engineering. Above all, he should be made to realize that the Golden Rule and the Ten Commandments, far from being out of date, are the only hopes that we have of making this world the world we think it should be.

Texas Section

Minutes of the Third Annual Meeting: *General Meeting:* F. C. Bolton, Chairman, Chemistry Bldg. Meeting called to order by Chairman F. C. Bolton at 3:15 P.M., April 21, 1933. Attention was called to the length of discussions and meeting turned over to B. P. Reinsch, who discussed a paper on "Psychological Principles Applied to the Learning Process in Engineering." Chairman Bolton suggested that a discussion of this paper and the subject of

Mathematical Training for Engineers be mixed. Discussion started by Rode of A. & M., followed by Richey of A. & M. and Godeke of Texas Tech. Dean Taylor of Texas commented on the paper and then brought up the subject of mathematical requirements for graduation from high schols. Dean R. A. Seaton of K. S. A. C., National President, discussed this problem as concerning the Kansas schools. Methods of meeting this problem at Texas A. & M. were discussed by Dean Bolton and Professor Porter. E. P. Schoch of the Chemistry Department at Texas University suggested that a demand be made for more mathematics to be taught in the high schools. Comments were made by Dean Adams of Texas Tech., Dean Flath of S. M. U. and Professor Pound as to this problem at their respective schools. Discussion was closed by interesting remarks by Dr. Ittlinger of the Mathematical Department at Texas University. Motion made by the Secretary and seconded by Rode that the chairman appoint a committee to draw up a summary of this discussion on mathematics in its relation to education in engineering and the physical sciences. Chairman appointed following committee to nominate officers for next year:

J. A. Focht, Texas, *Chairman,*
C. L. Svenson, Texas Tech.
L. B. Ryon, Rice
R. R. Slaymaker, S. M. U.
R. L. Peurifoy, C. A. & I.
F. M. Smith, N. T. A. C.
L. E. Grinter, Texas A. & M.

Committee on Resolutions as follows: Dean E. H. Flath, *Chairman,* S. M. U.; H. C. Spencer, Texas A. & M.; J. W. Kidd, School of Mines; J. S. Waters, Rice; and J. W. Ramsay, Texas.

Invitations were extended by Rice Institute and Texas Tech. for the meeting next year. Motion by Dean Taylor and seconded by Correll that the executive committee appoint a secretary from the school at which next year's meeting is to be held. Attendance about 75.

Banquet: F. C. Bolton, toastmaster, Austin Club, 7:00 P.M. President H. Y. Benedict of Texas University gave the address of welcome. Response for the National Organization by Dean R. A. Seaton, President, S. P. E. E. For the different schools as follows:

Rice Institute, L. B. Ryon
College of Mines, J. W. Kidd
Texas Technological College, Dean O. V. Adams
North Texas Agricultural College, M. C. Stone
Texas A. & M., L. E. Grinter
Southern Methodist University, R. R. Slaymaker
Texas University, Dean T. U. Taylor

General Meeting: Meeting called to order by Chairman at 10:00 P.M. Following committee appointed to report on discussion on mathematics: Dean Adams, Professor Correll and Professor Richey. M. C. Stone of N. T. A. C. presented a paper on "Shall Provision Be Made in the Future for Those Students Who Are Unable for any Reason to Satisfactorily Complete the Full Technical Course?" This paper called forth considerable discussion led by Dean E. H. Flath, Professors J. W. Calhoun, J. A. Correll, J. S. Waters, L. E. Grinter and Dean Adams. Adjourned, 11:15 P.M.

Group Meetings—Drawing: C. L. Svenson, Chairman, Biology Bldg., R-21. Two papers were presented, first by J. M. Miller of Rice on "Drawings and their Reproduction," second by C. E. Rowe of Texas University on "Teaching Descriptive Geometry by the Direct Method." After considerable discussion this group adjourned to the General Meeting.

Technical Laboratory: J. A. Focht, Chairman. A paper on "Laboratory Report Preparation" was presented by J. H. Pound of Rice Institute, who brought such questions as the amount of time required for performing the experiment and actual writing of the report. S. L. Brown started the discussion by outlining the elementary physics report and was followed by N. F. Rode on electrical engineering reports. Professor Thompson mentioned a special technical journal type report with a complete discussion at the end as is required in some civil engineering courses. C. C. Brant stressed the form of reports used in the textile industries, while H. F. Godeke was in favor of, first, an academic form of report for the basic courses, then a technical or commercial form for the major courses. R. H. Griffin, professor of English at Texas University, made a talk on "Sophomore English Courses for Engineers," outlining the history of English in connection with engineering courses, also stressing the importance which large companies lay on the use of English.

The nominating committee made the following report:

President: Dean T. U. Taylor
Vice-President: Dean E. H. Flath
Secretary-Treasurer:
Executive Committee:

J. J. Richey, Texas A. & M.
J. W. Ramsay, Texas University } 1935
J. H. Pound, Rice Institute

R. D. Campbell, S. M. U.
O. V. Adams, Texas Tech. } 1936
A. W. Straiton, C. A. & L.

F. M Smith, N. T. A. C.
H. C. Doremus, John Tarleton } 1934
J. W. Kidd, School of Mines

Moved and carried that report of the Committee be adopted. Suggested by chairman of this committee that representatives of different schools be chosen as above.

Report of Special Committee on Mathematics made by O. V. Adams, a copy of which is attached. Moved by E. C. H. Bantell and seconded that this report be mimeographed and copies be sent members of the Executive Committee for distribution. Carried. Motion by Dean Adams and seconded by J. J. Richey that in accordance with the resolution of the special committee on mathematics as stated in Resolution No. 2, that a committee be appointed to endeavor to work out a plan for such coöperation. Carried.

Report of Resolutions Committee as follows:

Resolved first, That the Texas Section of S. P. E. E. extend a vote of thanks to the faculty and officials of the University of Texas for the courtesies and hospitality extended our organization and for their efforts in making the 1933 meeting a success.

Resolved second, That we extend a vote of thanks to the Ladies' Committee for their splendid work in providing entertainment for the lady guests.

Resolved, third, That we express a vote of thanks to those members who have prepared and presented the papers and discussions which have made this meeting so interesting and helpful.

Motion made from the floor and seconded by Grinter that the above report be adopted. Carried. President F. C. Bolton expressed his approval of the arrangements of the program.

Motion made by Dean Taylor and seconded by C. L. Svenson extending an invitation to the National Organization to hold the annual meeting with the Texas Section in the future and especially in 1936 which is the Texas Centennial. Carried.

Moved by J. A. Correll and seconded by Dean Flath that the matter of dues be dispensed with for 1934. Carried.

Dean R. A. Seaton, National President, suggested that a full set of papers as presented at this meeting be sent to Secretary F. L. Bishop, also a copy of the minutes and a copy of the recommendations of the committee on mathematics.

There being no further business, the last paper of the meeting was presented by M. L. Begeman on "The Engineering Shop Courses." This was followed by discussions by representatives of the several schools who have a shop course.

F. E. Giesecke of Texas A. & M. suggested as a topic for discussion for the next year's meeting, "Uniform Requirements for Texas Schools." The meeting then adjourned.

Report of Committee on Mathematics: Your committee appointed to summarize the discussion of mathematics in its relation

to education in engineering and the physical sciences submits the following:

WHEREAS: Adequate training in mathematics is absolutely necessary in the study of all branches of engineering and the physical sciences and is becoming increasingly important.

AND WHEREAS: The trend in Texas schools is to minimize the value of mathematics and to reduce the graduation requirements in this subject.

AND WHEREAS: Even before this development many students in their first year in a college engineering course have been handicapped by inadequate preparation in mathematics partly because one or two years have intervened between their study of high school algebra and their entrance to college and partly because in many high schools the teaching of mathematics is entrusted to persons inadequately prepared to teach this subject.

AND WHEREAS: This trend if allowed to continue will result in engineering colleges and universities being compelled to give courses in mathematics which should be taught in high schools thus increasing the cost of engineering education.

Now, therefore be it resolved by the Texas Section of the Society for the Promotion of Engineering Education, that:

First: We deplore the existing situation as it affects students preparing for college work in these fields and that it is our conviction that all accredited high schools should offer at least 1½ units of algebra with not less than ½ unit in the senior year for the benefit of those students who, under the vocational guidance of the high schools, are planning to continue their education in the fields of engineering and the physical sciences.

Second: That the Texas Section of S. P. E. E. desires to cooperate with the Texas State Board of Education, the Texas State Teachers Association and any other interest group in dealing with this situation.

Third: That a copy of these resolutions be sent to the Texas State Board of Education, the Texas State Teachers Association and that a copy be given to the press.

REPORT OF CONFERENCE ON ENGLISH

Coöperation between engineering faculties and instructors in English formed the core of contributions to the sectional conference on English held at Corvallis, July 1, as part of the annual meeting of the S. P. E. E. The papers read, and the discussions ensuing, are here presented in condensed form.

(In opening the session, the chairman, **A. V. Hall** (University of Washington), spoke of the specific contributions of English to the education of a student—namely, training in the communication of ideas, both orally and in writing, and that enlargement of outlook through contact with ideas and attitudes unlike his own which Steinmetz has declared the greatest need in engineering education—and stressed the importance to the student of having his individual instructors, in both engineering and English, as actively coöperative as are the leaders in both fields.)

H. P. Hammond (Polytechnic Institute of Brooklyn): If there is any one problem on which there is universal agreement both in the engineering profession and in engineering colleges, it is that English is of paramount importance to the engineer. Good English is not simply a matter of transient training, but of long continued use, of *habit*. The English teacher can do much in the classroom and by individual consultation, especially the latter. But he cannot do everything. His colleagues, universally, both by insistence and by example, must continue the instruction in English which the teacher of English has begun. In several of our departments, in New York, coöperation with the English staff is so good that we are continually referring our work to them for criticism and correction. Not infrequently we send students to our English staff for personal help, which in our case is always forthcoming—although from what I have observed in other schools such coöperation may sometimes appear only on the surface.

It is becoming agreed that to put all the courses in English into the freshman and sophomore years is a mistake, that there ought at least to be some opportunity for the students to continue English work through into the senior year, perhaps not by providing more time, but by distributing it differently. We have done that for the last ten years at the Institute, and the results have been remarkably good. In our senior year we give a cultural option, where a student may elect from a group of broadening subjects, among them modern drama and literature, and Elizabethan literature. Students come back later to tell us how much they appreciated the opportunity

of taking such subjects when they had developed some degree of appreciation for them. For another thing, the requirement, as we have it, that a student, even a senior, may be required to do additional class work in English even if he has passed all his required English courses, if he becomes careless or slovenly, is a very healthy check on retrogression. One or two such instances noised about among the students have been a great help to those of us who insist on proper English.

Like the mathematics department, and the drawing department, the English department has its own unique place in the engineering college. It introduces the entire cultural division of our work, and the English instructors have a peculiar personal relationship with the students through the individual consultations they hold with them. They act almost as personnel officers—although I think sometimes they fail to realize the fact. Bearing these points in mind, we should exercise extreme care in our selection of English teachers.

Students fresh from high school, eager to get a taste of "real engineering" and impatient of the inevitable but somewhat boring necessity of continued work in such a subject as English, are rather likely to respect us teachers of engineering—as much as freshmen and sophomores respect anything—and to take our word for it that a given subject or topic is or is not important, particularly the latter. It is up to us engineers, then, to support our English colleagues, to hammer away persistently on the importance, the vital importance, of good English. We shall need fairly persistent prodding by our English friends, who will need to wage a deliberately organized campaign to make us conscious of our obligation to build up a definite consciousness of the importance of English in the mind of the student. I hope the English Committee of our Society may make this their major objective during the next decade.

WHAT ENGLISH SHOULD CONTRIBUTE TO THE TRAINING OF AN ENGINEER

I. C. Crawford (University of Idaho): Just as the training in such subjects as mathematics, surveying, mechanics, and technical courses inculcates the habit of starting from some fixed point, assembling facts, and reaching a solution based on a study of these facts, so should English training emphasize precision in the use of words, the orderly arrangement of ideas, and the presentation of the subject matter as a clear-cut picture. Training in speech should emphasize the same fundamentals. Courses in technical writing give the student a chance to write about subjects which claim his interest. For this reason the essentials of English com-

position may be emphasized again at this point, and with added force.

English training for engineers is not complete unless the student has had created within him a desire to read. A few minutes of the class period devoted to politics and world events will stimulate many boys to read the newspapers with discrimination. Suggestions relative to good biographies often bring results. Recommended lists of books, provided the lists are designed to appeal to young men of this type, have started the reading habit in many a student engineer.

English training for engineers is the combined work of the English teacher and the engineering teacher. The training started in the English department must be carried on in the technical courses; otherwise backsliding will certainly occur. The training is so important that both sets of instructors should emphasize it in every way possible. The graduating engineer should feel confident in his ability to write and speak correctly; in addition he should have acquired, formally or informally, a taste for the more serious and better types of general literature.

I am not a believer in adding more courses to the English work required in the engineering curricula. Unless these courses are selected by the students themselves, unless a desire for them has been created by the engineering department and the English department, they become merely another item of work which must be accomplished before graduation. I have a feeling, based on my own personal experience, that the greatest handicap to the development of proper English training in engineering schools has been the lukewarm or cold reception given to such training by engineering instructors themselves. They have relegated this training to an inferior position when compared to the technical work itself, and in addition have permitted themselves to become sloppy and indifferent with the use of English; in that way they have created an impression on the student that his English, in turn, is a matter of little importance.

As Director Hammond has mentioned, the coöperation appearing in catalogs and sometimes claimed by members of both faculties is often non-existent. In many cases immature persons without experience are assigned to engineering sections in English, with the result that the student, already slightly antagonistic to a non-technical subject, develops no interest in the work. To secure the results which we expect from training in English, we must have English instructors who are acquainted with the life we lead to-day, and particularly as it is applied to our scientific and engineering work. Secondly, if the work is to be at all effective, we must have as engineering instructors in the junior and senior years men of

breadth of training, who can bring to an engineering student an added enthusiasm, a feeling of the importance of a continued study of literature, and a desire to speak correctly and to be able to pick up a desirable type of reading.

DISCUSSION

J. H. Felgar (University of Oklahoma): One point occurs to me in this matter of coöperation. When our English department offers to reserve sections in English I for engineering students I immediately say, "You will not reserve sections for our students. This is the opportunity for them to come in contact with the other students on the campus." The engineers segregate themselves enough as it is.

J. M. Kierzek (Oregon State College): I wonder how much correlation there is between students' capacity to use good English and their actual use of good English. I think this is rather an important point. We English instructors are able to teach our students how to use good English, but it is up to the rest of the instructors, and up to certain sanctions and compulsions on the campus, to make these people continue their use of good English. Quite often a student who uses poor English in engineering courses knows better.

R. G. Tyler (University of Washington): I have some doubt as to a correlation between grades in English and the quality of work done by the student in engineering. An investigation has been made recently at the University of Washington in an attempt to predict the work of our entering freshmen, based upon high school records and certain placement tests. The data show a slight minus correlation as far as English is concerned. I do not attribute any significance to this result other than that there appears to be no definite correlation between the student's high school English and his likelihood of success in engineering. I mention this as a word of caution against trying to correlate things which are very different.

I should like to emphasize the advantage of moving English into the upper classes, where possible. It is unfortunate, I suppose, that we can't move all of our subjects into the junior and senior years of college, where we should have the advantage of more mature students. Since this cannot be done, we have to select those things which are of such primary importance that they should have this advantage. I think any of the instructors from my own institution could tell you that our experience in placing our freshman English in the junior year has been interesting. We think it has made the work much more effective.

Floyd Field (Georgia School of Technology): I think Mr. Hammond has struck one of the keynotes when he insists on the cooperation of the other departments. If the mathematics teachers, the physics teachers, the mechanics teachers, and all the engineering teachers, would insist that their work come in in legitimate and correct English, with the proper analysis, there wouldn't be any question as to these poor men getting as far as the senior class.

The mathematics department and the English department at the Georgia School of Technology are the two departments that cull out the students for the engineers. We have a non-credit course both in English and in mathematics. When the freshmen are taken in, they are put through a series of actual tests which group them according to their ability. Those in the non-credit course of mathematics, English, or modern language usually last one or two semesters, and that is the end of them. Then you have something to work on, after that.

THE COÖPERATIVE CORRECTION OF PAPERS

E. R. Wilcox (University of Washington): Some thirteen or fourteen years ago, the unsatisfactory results obtained in the usual freshman English courses led the engineering faculty to obtain from the English department an instructor who would act rather independently of that department and very coöperatively with the engineering college. At the same time, the required English, shortened to one three-hour course, was placed in the junior year. Later we put in rather a rigid test in the mechanics of writing, failing which the student was compelled to take a non-credit course, or otherwise make up the deficiency before entering the course in composition. Five years ago we added a second three-hour course, and moved the first one back to the last quarter of the sophomore year. This arrangement is working out well, but an additional quarter's work may soon be added; at present, in accordance with our suggestions, many students are already taking it as an elective, frequently in the department of Speech.

At about the same time that the two quarters of English was decided upon, the engineering staff approved a plan whereby one set of papers each quarter from every course in the freshman and sophomore years would be sent to our Engineering-English department, to be carefully corrected from the standpoint of English. We are well satisfied with the results.

In some courses the students know which papers are to be sent and in other courses they don't. As it has worked out, no papers are received from the mathematics department, who said their work didn't involve English; it was all symbolic. The chemistry

classes submit examination papers, some of the objective type, others requiring organized paragraphs. In the General Engineering department, which has the responsibility of looking out for these beginning students, we make a special point of obtaining correct English in classroom recitations. The majority of us take pains, all through the year, occasionally to hold some fellow up as horrible example to the rest of the class. It has its effect, in the changing of attitude at which we aim.

At the beginning of the year, I usually ask freshmen to list the subjects that were most interesting to them in high school, and those that were most disliked. At least seven times out of ten, the foreign languages and English are the ones most disliked or most difficult. In addition, the student coming into an engineering course thinks that the engineer is a doer, not a talker or writer. We point out to him, as the opportunity naturally arises in class, that one of the principal activities of the engineer, if he amounts to very much professionally, is the directing of others, and that in order to do so successfully, he must be able to organize his ideas and present them in a clear way that will not be misunderstood. I think in the course of the year's training the freshman gains a pretty fair idea of the value to him of English as a vital subject in his curriculum.

The matter of submitting these papers coöperatively to the English department does two things, I think. It makes plain to the student the fact that his engineering instructors regard English as very important, and it helps locate the student's particular weakness. The papers are usually graded on content, organization, sentence structure, and vocabulary, as well as on spelling, punctuation, grammar, and general neatness in appearance. Upon getting them back, the students are rather facetious concerning the amount of red ink spilled, but as a rule they do appreciate the effort that is being made. The English instructor lets it be known that she is glad to talk with any student who finds himself in difficulties, and some avail themselves of the opportunity.

The nature of the papers submitted may be of interest. In the first-quarter drawing course, Professor Warner has used various ideas, among them the happy one of having a paper on the value of engineering drawing to the particular branch of engineering in which the student is most interested; this is the starting point for some real thought on the subject. Another topic which has been suggested is the cultural value of a course in engineering drawing. In the Engineering Problems course, after a series of lectures on the nature and scope of the various fields of engineering the student is asked to write upon the field in which he is most interested, and to explain his particular interest in that field. Of course, these papers

are all read by the engineering instructors, and aid in their understanding of the individual student.

Papers from the elementary mechanics course in the second quarter are largely based on some engineering project of interest to the student, a description of some of the special engineering features that appeal to him. Descriptive Geometry provides a paper without much difficulty, except when some instructor refers to it as an "English theme," a label which usually destroys the whole effect. In our elementary surveying course comes an excellent opportunity to require the first engineering report our freshmen write. We have a little project in surveying, a survey and cost estimate for a short lateral sewer we contemplate putting in on the campus. The student makes the survey and the cost estimate, and writes a report on the project. We find this very effective indeed, and I think we get some remarkably good work.

In the sophomore year the papers are largely examinations and laboratory reports from the elementary steam courses. The physics department also sends over either examination papers or prepared work on such topics as "The Motor as a Generator." This last quarter it was decided to submit one report for each student in the junior course in hydraulics, which all engineers are required to take. This will enable us to check again on the habits the students have acquired, since this course normally follows the first course in English.

One thing occurs to me that I think should be stressed. I doubt very much if you can get satisfactory coöperative work of this sort by dealing directly with the English staff of the university as a whole. Unless certain instructors who are primarily interested in the engineering-English classes are placed in charge of this work, I doubt—from personal observation both as a student and as an instructor—whether you will have anywhere near the success that we have with the English separated as a distinct unit in the engineering college, and largely under the direction of a coöperative individual whose principal interest is in helping engineering students to acquire good habits in English and in stimulating an interest in good literature.

THE COURSES IN ENGLISH

Dean M. Ellwood Smith (Oregon State College): When Director Hammond, Professor Wilcox, and Dean Crawford stressed the quality, the character (I am speaking in the broader sense) of the instructor, and when Professor Wilcox spoke of selling the idea to the student, they all touched upon perhaps the most difficult but I think the most vital element in the whole program. I thoroughly

sympathize with what was said as to inexperienced young instructors being a source of difficulty. On the other hand, I have known young instructors to come in and make all sorts of blunders with regard to emphasis, and yet sell their subject by their enthusiasm, by their own real, genuine interest in the subject and their sympathy with the students they were working on. It is not so simple as looking over a personal data sheet and finding out how old the instructor is.

Somewhat suggestive, I think, is Whitehead's remark that style is the ultimate morality of the soul. Interpreted, it is after all the thing we must get over to our students—that style is the ultimate morality of the soul.

What do I mean? I simply mean that a man can't be honest unless he can say what he means. In dealing with students, I want to get them to the point where they will feel a responsibility to themselves for what they hand in, the same responsibility in signing their name on the back of a paper and handing it in as "my work" that they feel when they sign their name to a check. The study of English should mean to them more than the mere learning of a technique; it should mean the opportunity for developing a personality.

We have more or less gotten rid of the textbooks, I think, but we still have certain rather set terms. We talk about clearness, force, and eloquence, hackneyed and colorless terms which are sufficient to start a revolt in any modern group of undergraduates. In place of clearness, then, suggest a personality trait, integrity. As illustration, consider the writing of Lincoln; of course it is clear, but the outstanding quality that strikes you as you read is the fundamental integrity of the man who wrote it. In place of force, I would suggest another personal quality, mastery. When the person speaking knows his subject, is master of it, the force very largely takes care of itself.

I feel that the English as taught should contribute to education in this two-fold way: it should help a man, first, to be a master in the world in which he has to live, through economic competence, and, secondly, to be at home in the world in which he is a master.

I. FRESHMAN ENGLISH

Dean Smith here commented briefly upon a mimeographed survey of twenty-six institutions in the West, mentioning that the time devoted to English was somewhat less than the general average in engineering colleges, that some schools combine a study of literature with the work in freshman composition, that some use placement examinations, and excuse the best students from the course,

and that the engineering students are not as a rule segregated. For specific points, he referred the curious to these sheets.

II. TECHNICAL WRITING

A paper by **Carl G. Stroven,** University of Hawaii, definitely outlining the two-semester course in technical writing as taught in that institution, was given out in mimeographed form. Shortness of time also prevented the reading of a longer article by **Carl Naether,** University of Southern California, on "Aspects of the Course in Technical Writing," including both a general survey of the field and very specific and pertinent suggestions, based on actual experience, as to the content and method of a two-year course.

III. BROADENING AND CULTURAL COURSES

Dean Smith read the following statement from **Professor C. K. Judy,** California Institute of Technology:

The educational philosophy of the California Institute groups its non-scientific courses under the general head "The Humanities," a category which includes History, Philosophy, Economics, modern Languages and English as all joining in a common aim. What I can say for English considered alone must be understood, therefore, to be supported by other departments of work: *e.g.,* compositions are required in most of these departments and are judged on form as well as on matter; the "liberal" value of other courses marches with the liberal value of courses in Literature. And furthermore there is a growing coöperation between the instructors in science and the instructors in English composition: some, at least, of the science instructors insist on good English in the written reports handed them, and each of the engineering departments asks for the presence of an English instructor to act as critic in courses where oral reports are presented on engineering projects. It is of course universally desired that the boundaries of departments be only imaginary lines, and it is perhaps not necessary for me to have made this preliminary statement about the educational program of the California Institute.

English is considered in a two-fold aspect—technical and liberal: Through a large amount of practice in writing and speaking a graduate is expected to have at command a clear and forceful English; through reading he should have gained some information about literature, and, better, a taste for good books.

The limits of the requirement in writing and speaking are seen in the characteristics "clear and forceful." Emphasis is laid on exposition in writing, and on the plain and cogent statement of a

case in informal debating. The subjects assigned are preferably not in the field of science, for we have found that the men welcome the opportunity to read about and discuss topics of general social, political, and philosophic interest. The book of "Essays" used in the freshman year is some collection of articles by good modern rather than "classical" writers. Engineering and scientific essays have been tried, but, in our experience, with less success. Even, therefore, in the accepted freshman composition a liberal interest can be cultivated.

English as a medium for liberal education is never lost sight of. After the freshman year with its themes and discussions we have a survey of the most assimilable literature. Literary works are not treated with over-technical analysis. When a man shows an interest in poetic or prose style he is encouraged by the instructor to develop that interest: each year some one undertakes the study of the technique of modern poetry. The small sections (of some 16 to 20) make possible a good deal of flexibility in the direction of study. After the survey course, there are required in the senior year and in the fifth year courses in literature and philosophy.

Besides these regular and required courses there are offered two courses which are elective over the subjects required for the degree. The first of these, Summer Reading, is urged on all men during the long vacation. A varied list of books is printed and distributed, which guides the men in their reading, and a report is asked for at the time of the fall registration. The credit given is extra-curricular, but is recognized in a technical fashion so as to convince the men that the Institute encourages this sort of self-development. A second course, "Readings in English and History," lies between recreational and serious reading. The practice with us is to talk with each man about his background in literature in its broadest sense, and to discover his predilections. Books are then suggested which he reads and on which he writes a brief report which is discussed with him. Such reading is often elected by a man whose good general record allows registration for excess units. Normal credit is given, though credits thus acquired are in excess of the total required for the degree.

To summarize these notes I should point out that English courses are required in greater quantity than is usual in scientific and engineering courses (required first year, third year, two terms fourth year, optional in fifth year); that elective courses are chosen in addition to the requirement; that the various Humanistic Subjects are treated as a group, and are designed to produce engineers and research men of broad interests; and that all the effort is well supported by the trustees and faculty of the Institute.

Dean C. V. Boyer (University of Oregon): As I see culture, it consists in the full expansion of all our fundamental capacities. Looked at from another point of view, it is simply understanding things in their significances, understanding the relationships between things. If it is true, then, that all of us, fundamentally, have these large human interests, then the development of culture in any individual simply consists in tapping that interest at the point of its development where he comes in contact with it. The man of wide interests is always more valuable to society than the man of narrow interests. He understands others and coöperates with them instead of being in conflict. These are all matters involved in culture.

In the schools, we bring out this side of it very largely through biography, history, the novel and drama, and essays that consider the whole man. I think one of our difficulties, which has come out here in the discussion, is that our young men in engineeering haven't developed their interests equally at the time they enter college. We get them in rather large classes, and have difficulty in finding a subject or book that will attract the attention of all of them and further their interest at that point.

In presenting literature as a cultural study, I may draw upon some experience I had with engineeering students in the past, at Illinois, and illustrate by a course in Nineteenth Century Literature. Through the writings of Wordsworth, Byron, Carlyle, Ruskin, Matthew Arnold, Tennyson, Browning, and Huxley, students may understand our political, economic, industrial, and moral inheritance, may understand the whole development of industrial conditions and industrial life that didn't exist before. Enlightening their present outlook on life, and enabling them to understand more of the significance of things, this literature can give them what I mentioned a moment ago as training toward culture.

The use of literature of any period, of any sort, in such a manner as to connect the fundamental instincts of man, showing him all sides of nature, should awaken and satisfy the desires of the individual that relate to his broader culture. The engineering student should have, perhaps, one very strong bent toward some subject that may serve as a lead. Certainly he is an incomplete man, an abnormal man, if that is his sole interest. He will not fit into a community if simply that interest is developed, and I should think it would be better to work on the basis of a normality in presenting our cultural courses.

ENGLISH AT SPECIFIC INSTITUTIONS

C. E. Magnusson (University of Washington): I was greatly pleased at the lecture last night, in hearing Doctor Compton place special emphasis on cultural values inherent in engineering education, as well as in practical present-day engineering. With this thesis in mind it becomes evident that the purpose of required courses in engineering English need not primarily be cultural, but first and foremost should be to give the student training in how to express himself clearly and in good form. To succeed in his profession, the young engineer must needs know how to write good business letters, clean-cut professional reports and applications, and in general to be able to state clearly and concisely what he has to say.

Probably the main handicap to the successful teaching of English to engineering students is found in the illogical place given to English in most engineering curricula. The primary prerequisite to successful teaching is that the student must be deeply interested, and for engineering students this implies that the subject studied will be of practical value in his professional work.

A score or more years ago, one of our students flatly refused to register for English. When told that unless he completed the required courses in Freshman English he could not graduate, he replied, "I don't care, but I'm not going to waste my time on that 'stuff.'" He proved to be a good student, but during both his freshman and his sophomore year could not be persuaded to take English. At the beginning of his junior year his first request was for English composition. I asked, "Thomson, what has happened to you?" and he replied, "This summer I had to write a report on some engineering work, and my chief could not make head or tail of it. It is time I learned to express what I have to say."

The placing of English in the freshman year automatically erects a barrier to satisfactory instruction. Probably nine out of every ten engineering freshmen are not interested in English; in fact, they detest the work, and their main objective becomes merely to "get by" the professor—a worse than useless loss of time and effort.

Students can not be taught how to express themselves clearly, concisely, and effectively unless and until they have something to say. The most desirable place in the curriculum for English may be an open question, but it assuredly is not in the freshman year. At the University of Washington the required work in English is scheduled in the junior year. During each quarter of the freshman and sophomore years two papers (as in chemistry and physics) for each student are corrected for errors by the instructors

in engineering English. The corrected papers are then returned to the students, so as to call attention, six quarters in succession, to habitual or careless errors in English composition. An entrance examination is held in the sophomore year which must be passed satisfactorily before the student is permitted to register for engineering English in the junior year.

Students who fail in this examination are required to take a preparatory course, English B, without credit towards graduation. As a consequence, the students in the required courses in English in the junior year are keenly interested, and the results are entirely satisfactory.

F. E. Terman (Stanford University): Among the engineering faculty at Stanford we have no trouble with interest; I think everyone is one hundred per cent interested. Our principal problem is how to get the results we want. We require that all students in engineering take three units of oral English and nine units of composition, part of it in the sophomore year, and three units of it in the junior year. Oral English does not seem to present much of a problem; the students apparently regard the course as very much worth while. Many of us follow it up with oral work later in the engineering classes. As to the written work, the principal weakness is that in their engineering writing the students do not adhere to the highest standards of which they are capable. In the English courses they do; they put on their company manners.

Our students at Stanford are rather highly selected. Perhaps too, our tuition tends to make the students from homes more economically successful predominate. Most of them have little trouble with punctuation, or glaring grammatical deficiencies. The principal difficulty is that their work is sloppy, ambiguous as to technical meaning as well as poor in English. Our English instruction is undoubtedly too disconnected from the engineering work. The Engineering School has definitely decided upon the experiment of having perhaps twenty per cent of the technical papers—laboratory reports, examinations—revised by a member of the English faculty, some one with the proper sympathetic attitude. The students should then see that being able to write is a part of their engineering, and in consequence should lose their present attitude of resentment.

There is a danger, however, in limiting English to engineering subjects, or in limiting an English instructor to engineering students alone. Like any other subject, English should be kept up to its own professional standard.

The little objective evidence we have points to the fact that the average student does not improve his possibilities as a speller, or as a user of correct punctuation or grammar. More important, of

course is the ability to express oneself, which is not always correlated. We learn English in many places other than the classroom; after all, the few hours the college student is exposed to English, during his four years of college courses, is such an infinitesimal amount that it wouldn't be surprising if the English class had almost negligible results.

Another very interesting report, by **George H. Hinkle,** Stanford University, unfortunately did not reach the chairman in time for presentation at this meeting.

C. W. Park (University of Cincinnati): The emphasis by Professor Wilcox on habit forming is obviously, to me, the foundation for the type of coöperative, coördinated instruction, and we are hearing a great deal at this convention about coördinated engineering education. Certainly a student is using English in other than English courses Probably 90 per cent of the English he writes is for courses other than English. If he has not attained respect for English as a means of expressing ideas coherently, or if he hasn't the ability to translate his ideas into mathematical expression, or to present his concepts in terms of drawing, then something is wrong with his curriculum as a whole.

More than twenty years ago at the University of Cincinnati we made a very comprehensive examination of this whole subject, and adopted a policy of coördination between English and other subjects that runs from the freshman year to the senior year—that affects the first mathematics problem that the student turns into the mathematics department, and the senior thesis he submits at the close of the fifth year of the course. There is administrative machinery for checking and grading the student's English during each of these years.

On the practical side it is definitely understood that the English instruction in composition in the freshman year is intended to prepare him specifically for the type of writing he will do in non-English courses throughout the remainder of his stay at the university, and that he will inevitably be called upon to do in the practice of his profession beyond.

We have a further advantage there that answers the question concerning content that Professor Magnusson raised. I am convinced that by far the best papers that our students write, from the standpoint of their possibilities for encouraging the student to improve his English, is the correction of papers known as "work reports." The student has spent four weeks, let us say, at the Dalton Adding Machine factory, or at the White Motor Truck factory, or at the Studebaker factory. He writes a report which is not primarily for the English department, but is a report that is turned over to his coördinator, and is turned over to the foreman

or superintendent in the plant, a report that very frequently has a very definite bearing upon the student's promotion within the business organization. You don't need to insist so very strongly upon careful preparation of a report like that; the motivation is already there. You don't need to have the student go afield for content, because the content is there.

I once discussed this subject in a meeting at the Indiana University, and there happened to be a reporter present. Perhaps my emphasis was a little over strong, because he wrote for an Indianapolis paper an account of what I had said, and he accounted for the beginning of the coöperative course on the ground that the English department had need of bringing the student into contact with something tangible to write about, and in order to do this the university established a coöperative course whereby the students would work during a certain period out in the industry and would obtain subject matter to write on, and then would return to the college and present the material they had obtained.

We didn't inspire the coöperative system, but I take it that we should be remiss in our duty if we did not utilize and, if you care to call it such, exploit the possibilities of the writing that is inevitably done in connection with this practical work which the students do outside.

But I don't want to dwell on that phase. I should like to say just a word or two about the cultural side. I think we have two streams of thought here. At times they have come together. I hope they will come together permanently, and I should like to make just a brief gesture in that direction at the close of this discussion.

It seems to me that an attempt to isolate culture, to regard it as being in a water-tight compartment distinct from other forms of the pursuit of knowledge, is a lamentable attitude to take toward that subject. Certainly, as Doctor Magnusson pointed out, engineering has its cultural value, and I have known so-called liberal college people who were decidedly not that in their attitude toward the scientific side of our present-day civilization—who attempted to ignore it. I don't think you can separate, and I don't think you can teach culture as such. I don't think you can teach cultural English as such. I think it is always a by-product, but I think you can inspire it. There are many ways of doing that; I have found that one of the most direct challenges and one of the most likely to get results is to appeal to a student's pride of independent judgment in the matter of reading and oratory.

We spend most of our time on the literary side of English. Our emphasis at the beginning is on the decencies of expression simply for the sake of review, but we get over these as rapidly as possible

and take as many for granted as we dare, and then we proceed to a study of literature, for some of the interests and values that it offers.

A standard assignment is the preparation of a list of a dozen books called "My Waiting List." These are books which the student definitely plans to read next, and the list is accompanied by a statement, in a paragraph concerning each book, as to why he thinks he would like to read this particular book. This is a preliminary evaluation, and is followed later not by a formal report on the book but by an expression of the student's reactions: disappointed in some of the books, and pleased with the selection in other cases. He has learned a good deal in the process of following out and checking his own judgment, and although the guidance of the instructor is there, it is set as much as possible in the background.

NEW MEMBERS

AAKHUS, THEODORE, Instructor in Applied Mechanics, University of Nebraska, Lincoln, Nebr. O. J. Ferguson, W. L. DeBaufre.

CHURCH, AUSTIN H., Instructor in Machine Design, Cooper Union, New York City. Carl Rossmassler, Geo. F. Bateman.

CONNELLY, JOHN R., Instructor in Mechanical Engineering, Lehigh University, Bethlehem, Pa. F. V. Larkin, M. C. Stuart.

HOPE, HENRY B., Instructor in Chemical Engineering, Cooper Union, New York City. A. B. Newman, Geo. F. Bateman.

LUDDEN, DWIGHT J., Instructor in Drafting, Community High School, Granite City, Ill. A. S. Langsdorf, Edmond Siroky.

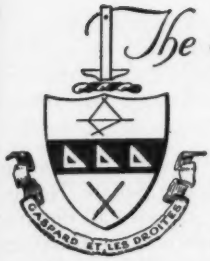
MITCHELL, DONALD H., Instructor in Graphics and Mechanical Engineering, Tufts College, Tufts College, Mass. W. E. Farnham, A. W. Leighton.

PALMER, DELOS M., Coördinator and Head of Mechanical Engineering, University of Toledo, Toledo, Ohio. I. F. Zarobsky, J. B. Brandberry.

REAGAN, LEWIS M., Instructor in Mathematics, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. Wm. J. Berry, H. P. Hammond.

YOUNG, C. HIGBIE, Instructor in Machine Design, Cooper Union, New York City. Carl Rossmassler, Geo. F. Bateman.

129 new members.



The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

Contrasts. In the October T-Square Page: ". . . America believes in Education, and because of this belief educational institutions should feel in a deeper sense the responsibility for justifying this confidence."

In a May bulletin from a prominent University: "No review of the destructive forces which have been attacking with increasing vigor the very foundations of the educational system of America is necessary. It is enough to say that these forces are so many and varied that every accepted value of education to-day is being questioned both honestly and dishonestly."

The Future? The October T-Square Page went on to state: "Engineering courses may well be inventoried during the coming year to ascertain whether or not they are accomplishing objectives in step with the times and in full accord with the respect and confidence which has been placed in them." That this has been and is constantly being done must be evident to all who read. That it must be done even to the point of action becomes increasingly evident.

Had engineering colleges been alive to an opportunity and sensitive to educational trends ten years ago, it is not improbable that to-day there would be no Colleges of Commerce.

Unless engineering colleges to-day face squarely an issue not dissimilar to that of ten years ago, it is not beyond the realm of probability that a new educational rival may accept the challenge of the day and provide a type of education somewhere in the middle ground between engineering and commerce and including the essential elements of both.

Engineering drawing teachers should be keenly scrutinizing their own work and teaching to keep it in step with current educational trends.

Annual Meeting. The program for the joint meetings of the Division of Engineering Drawing with the Committee on English, and the Committee on Orientation appear on the last cover page of the April issue of the JOURNAL. Teachers of engineering drawing will find in these programs, and in the annual competition in Engineering Drawing, much of interest and value "In the midst of such times of stress no one in the teaching force of this country . . . can afford to be intellectually idle."

COLLEGE NOTES

The **University of California** Senate recently voted to change its organization. As now constituted the Academic Senate, Northern Section, has headquarters in Berkeley. It includes all departments in Berkeley, the Medical and Dental Schools and the Hastings College of the Law in San Francisco, the University Farm at Davis, and Lick Observatory on Mount Hamilton. The Southern Section of the Senate comprises the various departments of the University of California at Los Angeles, the Branch of the College of Agriculture and Citrus Experiment Station at Riverside, and Scripps Institution of Oceanography at La Jolla. President Sproul will, by arrangement of the times of meeting, preside over both Sections.

The long-established requirement of physical education for freshmen and sophomores of both sexes was abolished by the Senate at its April meeting. The facilities for and the advantages of voluntary physical education will in no manner be curtailed. It is hoped that the splendid new gymnasium for men, recently completed, will encourage and continue such activities on nearly the same scale as before.

In the Colleges of Engineering and of Mining that elimination results in a reduction from 16 units each semester to 15½ units for freshmen, and from 18 units to 16½ units each semester for sophomores. The latter reduction was brought about partly by a change in the administration of the legal requirement of a two-unit course in American institutions. The total number of units for graduation in the four-year curriculum is now 136 instead of 140 in the College of Engineering, and 139 instead of 143 in the College of Mining.

The heavy reduction in the budget for the next biennium, enacted by the California legislature, will call for rigid economy in all departments, both in salaries and in equipment and supplies. Whether or not it will be necessary to charge additional fees has not yet been determined. Many hoped-for betterments in the engineering laboratories will of necessity be deferred until such later time as the required funds may be available.

For the first time it was found necessary this year to hold the Commencement exercises in two parts. On May 12 the professional and higher degrees were conferred upon over 1,000 students. On the following day bachelors' degrees were conferred upon 1,784 students in the colleges of Agriculture, Chemistry, Commerce, Engineering, Mining, and Letters and Science.

An honorary degree of Doctor of Laws was conferred upon Mrs. Lillian E. Gilbreth, Consulting Engineer, a graduate of the University of California in the class of 1900. The same degree was conferred upon Professor Edmond O'Neill, California, 1879, Professor of Chemistry, Emeritus. Due to severe illness Professor O'Neill was not able to be present, but President Sproul publicly proclaimed the degree. Immediately following the exercises he went to the bedside of Professor O'Neill and there conferred the degree upon him personally in the presence of a number of interested witnesses.

The third honorary degree of Doctor of Laws was conferred upon Dr. Alexander Meiklejohn, Professor of Philosophy at the University of Wisconsin, director of the experimental school there, and formerly president of Amherst College.

The Ohio State University.—The Department of Chemical Engineering at The Ohio State University will offer a continuation of its usual Summer Program which will include fundamental lecture and laboratory courses in Chemical Engineering and Industrial Chemistry for Graduate and Advanced Undergraduate Students and research courses for graduate students. Formal lecture work in the field of organic chemical industry will be offered while formal laboratory work will be largely devoted to the technical testing, analysis and evaluation of the products of Chemical Industry based upon the standard methods of the American Society for Testing Materials. Usual opportunity has been provided for graduate students to carry on Chemical Engineering Investigations involving the use of large scale equipment and an extensive supply of miscellaneous research apparatus and equipment will be available. There will be opportunity for advanced work in related fields in Chemistry and other Departments. Programs of graduate students will be arranged to permit them to take such advantage as they may desire of the offerings of other Departments. Inquiries should be addressed to Dr. James R. Withrow, Professor of Chemical Engineering, The Ohio State University.

BOOK REVIEWS

The Technical Man Sells His Services. EDWARD HURST, McGraw Hill Book Co., New York, 1933, $2.00.

Needless to say this book is timely, but at the same time it is surprising and inspiring. The first impression on reading the first two or three chapters is certainly one of surprise and perhaps a little chagrin. The exposition of the scientific approach certainly shows up in its true colors the average engineering graduate's timid way of asking for a job. It is all the difference between asking for a job and going after one. The next few chapters are likely to make him ask "How does this apply to me?" This question will gradually be answered as he reads further. Finally the inspiration comes and the reader resolves to go out and land a job. We hope he succeeds.

The book is simply a recital of ten stories of young graduates who, through the use of original thought and not a little work, have landed jobs when it seemed hopeless to even ask. There is no doubt as to the interest of these stories. The only question is "Will reading it help the graduate get that job?" As far as can be determined by a very short period of use it will. It has been used in senior classes at M. I. T. for the past year. If it fulfills its promise it should be in the hands of every graduate.

Conduction of Electricity in Gases. No. 38 in the Series of Westinghouse Extension Courses, by J. SLEPIAN, Consulting Research Engineer; Westinghouse Lecturer in Physics, University of Pittsburgh. iv + 188 pages; 8½ x 11; 180 diagrams; cloth; $4.00 net.

The purpose of this course is to study the phenomena attending the passage of electricity through gases. Particular attention is paid to the fundamental principles involved and their application to the study of such discharges as glows, arcs, sparks, and corona.

Many of the recent significant and important developments in circuit interruption, lightning protection, power rectification, and general arc theory are discussed.

Among the subjects treated are: Kinetic Theory of Gases, discussing pressure effect, evaporation of electrons from metals, diffusion phenomena, applications of the theory, etc.; Electrical Properties of Gases, covering mobility and methods of its determination,

ionization, effects of the material, glow discharges, extinction of a.-c. arcs, dynamic characteristics of an arc, etc. A short bibliography is included.

This course is an outgrowth of a graduate course in the University of Pittsburgh. The known quality of Dr. Slepian's work is the course's best recommendation.

Copies of this course can be obtained on application to the Supervisor of Extension Courses, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Mine Examination and Valuation. CHARLES H. BAXTER, Professor of Mining Engineering and Economics, and ROLAND D. PARKS, Associate Professor of Mining Engineering, Michigan College of Mining and Technology. Houghton, Mich., Michigan College of Mining and Technology, 1933. 316 pages. $3.00.

The authors of this text have ventured to assemble the essentials of ore mine examination and valuation in one book. Coal mines are not treated specifically.

Part I, which is about half of the text, is devoted to the methods of sampling, the necessary computations and the use of the results. In this part, numerous diagrams are used for illustration. The general aspects of examination are included, also a brief treatment of mine economics. Part II is assigned to valuation and is concerned largely with the mathematics of investment and its application to mine problems. An excellent feature is the complete solution of a series of practical examples. The more important standard formulas, generally known by the names of their authors, are stated and discussed briefly. To facilitate solution of problems, tables are included, some of which are new.

In an appendix the Michigan system of appraisal of mines for taxation is described by Franklin G. Pardee, the State Appraiser of Mines. On account of the extensive study given to this question in Michigan by recognized authorities, a summary of the subject in about fifteen pages is valuable.

The bibliography at the end of the book lists articles in periodicals, papers in proceedings of technical societies and books. Some of the references cover material very recently published.

R. M. B.

Handbook of Mathematical Tables and Formulas. R. S. BURINGTON, Handbook Publishers, Inc., Sandusky, Ohio, 1933. $2.00 ($1.25 to Students).

This is a very useful compilation of tables of facts and figures especially used in engineering and physics. The first section of the book contains formulas and theorems from elementary mathe-

matics, algebra, geometry, trigonometry, calculus, vector analysis, etc.; and the second part is a group of much used tables including logarithms, functions, radians to degrees, interest tables, probability functions and many others. The book is well set up, being easier to read than the usual book of tables. The arrangement is also excellent. This book is highly recommended for college students of mathematics.

The Students' Guide to Good Reading.—At the Session on English of the Society for the Promotion of Engineering Education held last July at Ohio State University, a group of the English instructors met informally one afternoon and initiated a project which promises to be of considerable value in stimulating the interest of undergraduates in good reading. The motivating idea was that students might be more effectively interested in good books if these were recommended to them, not *ex cathedra* by their instructors, but through the frank opinions of other undergraduates. Therefore the group formed itself into a committee to sponsor a STUDENTS' GUIDE TO GOOD READING to be made up of reviews by students of books they had enjoyed, these reviews to be secured by means of competitions in various colleges.

In the development of the plan a preliminary list of recommended books was compiled by the committee under the editorship of its chairman, Dr. Atwood H. Townsend, of New York University. This list was restricted to books available at one dollar or less in various reprint series, such as Everyman's Library, Modern Library, World Classics, A. L. Burt, and Grosset and Dunlap. It includes about six hundred titles with one-line descriptions of each book. An edition of seven thousand copies of this list was printed, the expense being borne by the leading publishers of reprint series. These and other publishers have also contributed several hundred volumes to be given as prizes for the best book reports by students in the participating colleges. The subsidized first edition has been completely exhausted by requests from twenty-five colleges.

Next fall the committee intends to issue an enlarged edition of the list, including as many as possible of brief book reviews by students. This second edition will be made available to colleges generally, and it is expected that between 20,000 and 50,000 copies will be required. The plan is to continue annual editions until the ultimate objective is reached of a *Guide to Good Reading* written by students for students.

The members of the original committee in attendance at the S. P. E. E. Session on English were:

Robert L. Blair, University of Illinois
C. F. DeLaBarre, Virginia Polytechnic Institute
Thos. L. Donahue, Polytechnic Institute of Brooklyn
F. J. Fassett, Jr., Massachusetts Institute of Technology
L. O. Guthrie, University of Minnesota
L. R. Lowe, Case School of Applied Science
J. H. McKee, Purdue University
Harold W. Melvin, Northeastern University
J. Raleigh Nelson, University of Michigan
Clyde W. Park, University of Cincinnati
Atwood H. Townsend, New York University
J. L. Vaughan, University of Virginia

This project, although it was started by a group of teachers of English to engineers, is not restricted to technical schools. Among the other colleges which have since become participants in the project are the University of Alabama, Albright College, Alfred University, American University, Bucknell University, University of Colorado, University of North Carolina, University of Oregon, University of Tennessee, Tufts College, University of Washington, and Wellesley College.

For information, address the chairman of the Intercollegiate Committee on Students' Reading, Atwood H. Townsend, New York University, New York City.

Theory of Thermionic Vacuum Tubes. E. Leon Chaffee. McGraw Hill Book Co., New York, 1933, $6.00.

This text and reference book is on the theory of the operation of low power vacuum tubes. A second book is to follow, at least according to present plans, to cover power amplifiers and oscillators, gas-content tubes, rectifiers and other high power vacuum tubes.

Although primarily a textbook there is such a mass of detail given, and such a relatively small field is covered that it would seem that the book will probably find its greatest use in reference work. The book is rather mathematical and suited only for senior or graduate courses, but to simplify matters, many of the detail sections are marked with an asterisk and may be omitted on first reading. The most valuable thing in the book is the large number of instructive and well drawn graphs both in two and three coördinate systems which simplify the mathematics. Some new material is included on the path of operation, large signal regeneration, regeneration in coupled circuits, detection, and non-linear elements. The book should be extremely valuable to graduate workers for whom it fills a great need.

F. L. B., Jr.

Analytical Mechanics for Engineers. SEELY AND ENSIGN. Second edition. John Wiley & Sons, Inc. $3.75.

In this second edition the authors have maintained the same high standard which prevailed in the first edition.

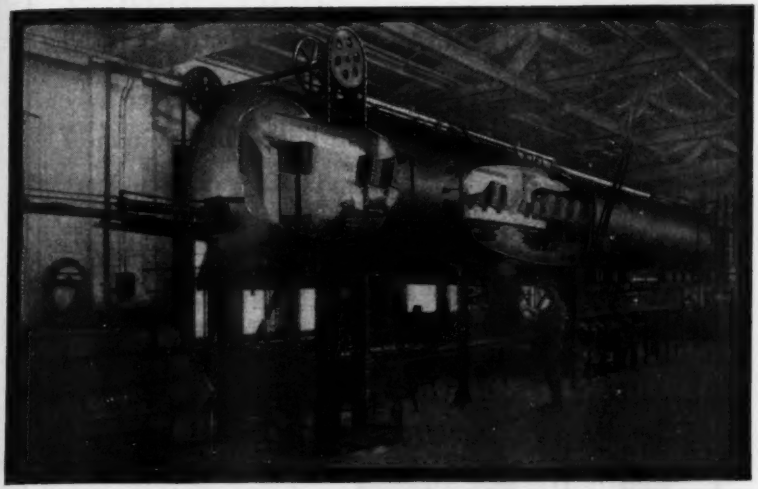
The following changes are to be found in the present edition: new material, new figures, and a large number of new problems, together with questions and problems following each chapter thereby assisting the student materially in his review of the chapter in question.

The text is divided into three main topics, namely, statics, kinematics, and kinetics. While the second edition is still somewhat large for the average course in mechanics, due to the arrangement of the text omissions can be made to suit the needs of the individual instructor.

R. F. E.

Engineering Shop Practice, Volume 1. O. W. BOSTON, John Wiley and Sons, New York, 1933. $5.50.

This book is a text and reference book in machine shop practice for upper class students. The first volume covers the commoner tools and machines used in the shop and the second (in preparation) will cover the smaller and less important tools as well as the economics of the shop. Although it appears to the reviewer that the great amount of material presented in the book is more suitable for reference than text work; at the same time, in the hands of a capable instructor who could point out the essentials the book should be valuable as a text. The book is notable for the fine microphotographs and graphical analyses of the different operations. More than four hundred illustrations make all the machines and their uses plain. It is of interest to members of the Society that the book is dedicated to Mortimer E. Cooley.



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PUBLICATIONS OF THE SOCIETY

The JOURNAL OF ENGINEERING EDUCATION is the official publication of the Society for the Promotion of Engineering Education. It is published monthly from September to June inclusive. Vol. XXIII begins with the September, 1932, issue. $3.00 per year.

A bound volume of the Journal for each current year constitutes the PROCEEDINGS of the Society. Subscriptions should be made not later than September 15 for the succeeding volume. Orders for Vol. XL, 1931–32, should be placed now. $3.00 per volume. $2.50 to members.

Report of the INVESTIGATION OF ENGINEERING EDUCATION. From 1923–29, this Society conducted a comprehensive study directed to the improvement of engineering education. The enterprise was co-operative and engineering schools actively participated. Engineering societies, industries, governmental agencies, and individuals also co-operated. Visits were made to the engineering schools of this country and of Europe. An intimate knowledge of conditions essential to the evaluation and interpretation of information gathered was thus gained. Reports were issued from time to time. These have been gathered together now into one volume of 1039 pages. $3.00 per copy.

A STUDY OF TECHNICAL INSTITUTES was conducted by the Society as a collateral project to its extended investigation of engineering education. An advisory committee, representing the technical institutes and other interests affected by the study, assisted the staff in formulating the scope and objectives and in reviewing the general findings and conclusions. A report of 281 pages has just been published. $1.00 per copy.

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PROGRAM OF THE CONFERENCE OF ADMINISTRATIVE OFFICERS OF ENGINEERING COLLEGES HELD UNDER THE AUSPICES OF THE BOARD OF INVESTIGATION AND COÖRDINATION, S. P. E. E.

University of Wisconsin, Madison, July 3 to 7, 1933, inclusive.

July 3.

9:30 A.M. Opening session	Charles F. Scott, Chairman, Board of Investigation and Coördination, S. P. E. E., presiding
What is Happening to Engineering Education? A symposium led by	H. S. Rogers, Oregon State Agricultural College With discussions by M. L. Brittain, Georgia School of Technology, H. S. Evans, University of Colorado, Willard C. Hotchkiss, Armour Institute of Technology, R. L. Sackett, Pennsylvania State College
P.M. Session on Financial Problems	R. A. Seaton, Kansas State College, presiding
The Financial Outlook for Higher Education in the Next Decade	Charles R. Mann, Director, American Council on Education
General Discussion	

July 4.

A.M. Session on Personnel Matters	F. E. Turneaure, University of Wisconsin, presiding
What Can We Do to Aid the Student Affected by the Depression?	Edward C. Elliott, Purdue University
Recent Engineering Graduates	Paul Cloke, University of Maine
Education for Unemployed Engineers	J. W. Barker, Columbia University
P.M. Session on Administrative Problems	F. L. Bishop, Secretary, S. P. E. E., presiding
Faculty Aspects	Dexter S. Kimball, Cornell University
Budgeting and Finance	O. M. Leland, University of Minnesota

July 5.

A.M. Session on Faculties	Paul Cloke, University of Maine, presiding
Selection and Development of Faculties	J. W. Barker, Columbia University
General Discussion	
P.M. Session on Graduate Work	Dexter S. Kimball, Cornell University, presiding
Function of the Administrative Officer with Reference to Graduate Work	Dugald C. Jackson, Massachusetts Institute of Technology
General Discussion led by	R. A. Seaton, Kansas State College

July 6.

A.M. Session on Junior Colleges	R. L. Sackett, Pennsylvania State College, presiding
Junior Colleges and Their Relationship to Engineering Education	George F. Zook, University of Akron Discussion by H. C. Sadler, University of Michigan, and F. C. Bolton, Agricultural and Mechanical College of Texas
P.M. Reserved for symposium on topics suggested by members of the Conference	President-Elect of the Society presiding
Evening. Public Address. Engineering Education in the Light of Changed Economic and Industrial Conditions	W. E. Wickenden, Case School of Applied Science

July 7.

A.M. Session on External Relationships of Engineering Colleges	Dugald C. Jackson, Massachusetts Institute of Technology, presiding
The State and Engineering Education	H. H. Horner, Assistant Commissioner for Higher Education, The University of the State of New York Discussion by P. H. Daggett, Rutgers University, and C. C. Williams, State University of Iowa
The Problem of Accrediting Engineering Colleges	Karl T. Compton, Massachusetts Institute of Technology, and H. P. Hammond, Polytechnic Institute of Brooklyn

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